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THE PRACTICAL RAILWAY SPIRAL

WITH SHORT WORKING FORMULAS
AND FULL TABLES OF DEFLECTION
ANGLES: COMPLETE NOTES OF IL-
LUSTRATIVE EXAMPLES :: ::

BY

*made
by*
L. C. JORDAN, B.S., C.E.

PRINCIPAL OF CIVIL ENGINEERING DEPARTMENT,
HEFFLEY INSTITUTE, BROOKLYN, N. Y.

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NEW YORK
D. VAN NOSTRAND COMPANY
25 PARK PLACE

1913

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PREFACE

THE purpose in presenting this treatise is to clear up and modify the theory and to eliminate the existing inconsistencies of spiral curves. "The Practical Railway Spiral" has been chosen as the title on account of its being the most appropriate name for a curve easement whose principles have been founded upon the actual requirements of such a curve as dictated by the demands of location, maintenance, and operation. The author has had considerable experience on railroad maintenance—in actual track work itself—and on location, both in mountainous country and on the plains. And after his experience in both lines of work and an extensive study of spirals in general and of the practice and requirements of many of the best American railways, he has developed "The Practical Railway Spiral" as the closest possible approach to the perfect curve easement.

Maintenance demands spirals of a constant length and which will permit a uniform increase of superelevation except near the ends where the run-off is always tapered out by means of slight vertical curves. Location demands a spiral of comparatively short length which may be easily and quickly figured, readily understood by surveyors, and quickly and accurately staked out. Further demands are that the spiral shall be computed along with the simple curve, shall provide an easy means of checking the work as a whole, shall be adaptable to rough country as well as smooth, and shall be located in the same general manner as are simple curves. By far the most important requirement of the ideal curve easement is that it shall furnish a safe and smoothly riding surface and alignment for the rolling stock. All of these factors, together with important minor details, have been taken into account in the design of the spiral herein presented

"The Practical Railway Spiral" has been developed according to an entirely original method. It is complete in theory, simple and practical in construction, elastic in its adjustment to conditions of speed and curvature, and readily applicable to all classes of location and revision work.

The theory and development of "The Practical Railway Spiral" are entirely free from approximations. Thus satisfactory results are insured so long as the field work is accurate.

The tables give all angles and other functions for four different lengths of spirals for all degrees of curvature ordinarily employed. Angles and dimensions for spirals of peculiar degree may be readily found by short working formulas and simple, direct proportion.

The writer wishes to express his gratitude for the information so generously advanced by the chief engineers of fifty-nine railways of the United States and Canada. This information proved to be a great help in the present work.

BROOKLYN, N. Y.,
November 15, 1912.

L. C. J.

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INTRODUCTION

BEFORE beginning actual work on this treatise, the author sent out letters of inquiry to the chief engineers of all the principal American railroads. The questions asked were in regard to the customs on the several systems as to the maximum degree of curvature, maximum superelevation of outer rail, minimum degree of curve spiraled, length of spirals used for different degrees of curvature, etc. The object in this investigation was to ascertain the customs on the railways as regards curve easements, and, if possible, to draw up rules, formulas, and tables for a system of spirals that would satisfy what appeared to be the best customs on the largest number of railroads. A total of fifty-nine answers was received. Of these, some were incomplete. The satisfactory replies showed such a state of chaos that it was found impossible to design a spiral that would satisfy the customs on even a greater number of the principal railways. A deal of the disagreement of the practice on different systems seems to have been caused by the difficulties incident to the introduction of spirals on lines that had been primarily located with simple curves and tangents and the carrying of the resulting haphazard methods into the location of new lines. As a result, systems of the same general style, lying in similar territory, and having practically the same amount and nature of traffic employ, under like conditions of curvature, spiral curves which differ entirely from each other in length and which have substantial differences in other respects. Often some particular railway uses a system of spirals which, in itself, gives evidence of radical inconsistency for which there seems to be no reason or excuse.

Some of the newer roads show better system. But, even they do not agree strictly with one another in regard to some

of the determining factors of the spiral. Some railways vary the length of spiral with the degree of curvature, some vary it with the amount of superelevation of the outer rail, others vary the length with the velocity of the fastest train, and still others vary the length with the product of two of these factors. Then, too, there are the railways which use the shortest spirals with the sharper curves, and others which employ a constant length of spiral for all curves. These latter are among the newer railway systems which have profited by the experience and mistakes of the pioneers. A great many of the older railways, as they expand and locate new lines, change their practice in curve easements. The new roads, as they come into existence and draw up standards, make wide departures from the customs of the original systems. In these changes of standards and practice there is a general tendency toward greater uniformity in length and the elimination of excessively long easements. In this convergency of principles after a chaotic beginning there is evident a call for a simple and elastic spiral that affords a possibility of uniformity in itself and which is designed to meet economically the requirements of rolling stock and which is easily kept in adjustment by track men.

“The Practical Railway Spiral” hereinafter developed and explained is the result of the aforementioned experience, study, and observations. A careful and intelligent study will insure a thorough understanding, as positively no call to the imagination is made.

THE PRACTICAL RAILWAY SPIRAL

CHAPTER I

SUPERELEVATION

1. **What it is and Reasons for it.** On straight railway line the track is always kept level for obvious reasons. If the track were kept level transversely on curves, the centrifugal force due to the curvature and the train velocity would tend to tip the cars outward. In fact, it would rock the cars on the truck bolsters. And this inclination, together with the ever present centrifugal force, would further tend to roll the cars outward. Under such conditions, the only force holding the train onto the track is the pressure of the wheel flanges against the outer rail. Therefore, it is customary to incline the track inward. The amount of elevation of the outer rail above the inner one is called the "Superelevation."

2. **Theoretical Amount of Superelevation.** It is customary to give the outer rail a superelevation of such value that the fastest train—the best passenger train—will feel to the occupants as though it were on straight and level track. In other words, the resultant of the weight and the centrifugal force must be perpendicular to the axles of the wheels. From mechanics it is found that the superelevation required by a certain train is,

$$E = 0.00068 V^2 D, \quad (1)$$

where E is the superelevation in inches, V the train velocity in miles per hour, and D the degree of curvature. As the superelevation varies with the square of the velocity, it

differs greatly for the many train speeds to which any one line is subject.

3. Effect of Rigid Axles. This theory would be complete if cars and engines were constructed with loose wheels as are wagons. But the rigid axles cause a tendency of the wheels to run straight ahead so that there is always a great flange pressure upon the outer rail. Even a handcar will flange the outer rail, no matter how low the speed nor how great the superelevation.

4. Amount of Superelevation Given. According to the best practice, the superelevation is reckoned by formula (1) for the fastest trains, although there is considerable flange pressure. And the slower trains exert a diminished flange pressure and have a tendency to tip inward.

5. Velocity Limited by the Superelevation. Expressed in different form, formula (1) becomes

$$V = \sqrt{1470.6 E/D}. \quad (2)$$

Table I has been calculated from formula (2). It shows the highest allowable velocity on curves with D varying from

TABLE I
SHOWING ALLOWABLE VELOCITY ON CURVES

$$(V = \sqrt{1470.6 E/D}).$$

D = degree of curvature

Values of E .	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°
$\frac{1}{2}$ "	27.1	19.2	15.7	13.6	12.1	11.1	10.3	9.8	9.0	8.6
1	38.4	27.1	22.1	19.1	17.2	15.7	14.5	13.6	12.8	12.1
1½	47.0	33.2	27.1	23.5	21.0	19.2	17.8	16.6	15.7	14.9
2	54.2	38.4	31.3	27.1	24.3	22.1	20.5	19.2	18.1	17.2
2½	60.6	42.9	35.0	30.3	27.1	24.8	22.9	21.4	20.2	19.2
3	66.4	47.0	38.4	33.2	29.7	27.1	25.1	23.5	22.1	21.0
3½	71.7	50.7	41.4	35.9	32.1	29.3	27.1	25.4	23.9	22.7
4	76.7	54.2	44.3	38.4	34.3	31.3	29.0	27.1	25.6	24.3
4½	81.4	57.5	47.0	40.7	36.4	33.2	30.8	28.8	27.1	25.7
5	85.8	60.6	49.5	42.9	38.4	35.0	32.4	30.3	28.6	27.1
5½	89.9	63.6	51.9	45.0	40.2	36.7	34.0	31.8	30.0	28.4
6	93.9	66.4	54.3	47.0	42.0	38.4	35.5	33.2	31.1	29.7

one degree to ten degrees, inclusive, and E varying by half inches up to 6 ins. This form of table is most convenient when we consider that a certain curve with a given superelevation limits the speed of the fastest trains, as is frequently the case in the present age of high speed. Locomotive engineers, after becoming accustomed to a certain "run," know on what sections of the line they must reduce speed on account of sharp curves and on which stretches of track they can "let her out," as they express fast running. Or, in other words, the speed is limited by certain curves when the standards of the company limit the superelevation to a specified amount. When 4 ins. is the maximum allowable superelevation, as is the case with some large systems, 38.4 miles per hour is the maximum velocity on a four-degree curve, and 54.2 is the speed limit on a two-degree curve. Consequently, an engineer would have to reduce his train velocity to the above values on these curves, while on tangent he could make up for lost time due to the delay on the unfavorable alignment. This limiting of the superelevation and of velocity has its effect upon spiral curves, but this matter will be taken up in its proper place.

6. The Run-Off. At the curve ends, when no spiral is employed, it is customary to trail out the superelevation onto the tangent. This length of track, in which the superelevation is attained, is commonly termed the "run-off." Although a vast number of curves with their run-offs on straight track are in use, they are highly objectionable and should be avoided when possible.

7. Flange Clearance. There is always a space allowed between the wheel flanges and the inner edges of the rails or gauge lines. This clearance amounts to about 1 in. that is, the wheels would run, but would flange both rails if the track gauge were reduced approximately an inch. This clearance is necessary for free running, making allowance for irregularities in the gauge, and is required on curves where wider gauge is needed by two or more axles coupled together, as in car trucks and engine driver frames.

8. Effect of Clearance on Straight Run-Off. When straight track is inclined transversely, as in a run-off on tangent, all wheels slip to the lower rail. Upon approaching a curve under such conditions, all trucks are flanging the inner rail. Her-

the rigid axles come into play and carry the wheels straight ahead until the opposite flanges strike the outer rail. A shock is then produced which knocks the track out of line and an outward kink is the result. Trains in the opposite direction and flanging the outer rail enter this kink and cause further distortion. The farther the track is thrown from its proper position, the greater becomes the resulting shock of trains in either direction. And the track soon takes the form shown to an exaggerated scale in Fig. 1. This form frequently becomes very noticeable.

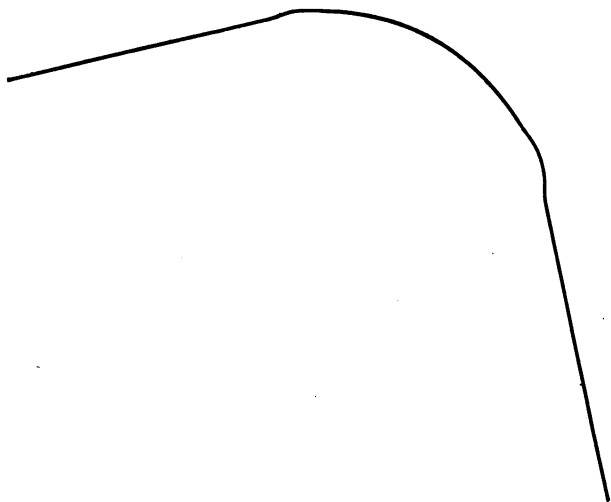


FIG. 1.—Showing effects of shock produced by run-off on straight track

CHAPTER II

THE CURVE EASEMENT

9. Practical Conditions. In order to eliminate the aforementioned difficulties due to a run-off on straight track, it has been the custom to introduce a curve easement or spiral. A spiral is a curve of varying degree which provides a gradual change from tangent to curve and vice versa. The length of spiral should coincide with the run-off, and should be of such form that the degree is proportional to the superelevation at nearly all points. Heretofore, it has been customary to design spirals with the degree of curvature varying uniformly from zero at the flatter end to the degree of main curve at the sharper end. This idea would be almost correct if there were no flange clearance, if the wheels were loose and if the superelevation were gained at an exactly uniformly varying rate throughout. But, as has been previously stated, none of these ideal conditions actually exist. Rigid axes are used. Flange clearance is always allowed. And section foremen, when "surfacing" track, always insert slight vertical curves at the ends of the run-off, while in the main part of the run-off the grade is regular. The change from level to superelevated track then has the form shown in *a*, *b*, or *c*, of Fig. 2, according to the practice of different railways. No matter which method is used, the results are identical. Since these conditions exist, it is best to make allowance for them. When E varies as indicated in Fig. 2, if D were always proportional to E , allowance would be made for the acceleration of the transverse tilting of the cars upon entering the spiral, and for the retarding of this motion before entering the main curve. It is evident that this would aid greatly in steadying the train. Besides, there still exists, in a much reduced form, the shock mentioned in

Art. 8. While on straight track, some wheels flange one rail, some are in contact with the other, and others run freely. Upon entering the spiral, the wheels already in contact with the outer rail pass smoothly around the curve, producing no shock whatever. But all others must strike the outer rail a blow, the force of which depends upon the weight of wheel and load, and the train velocity, and also upon the angle between the rail and the direction of motion at the

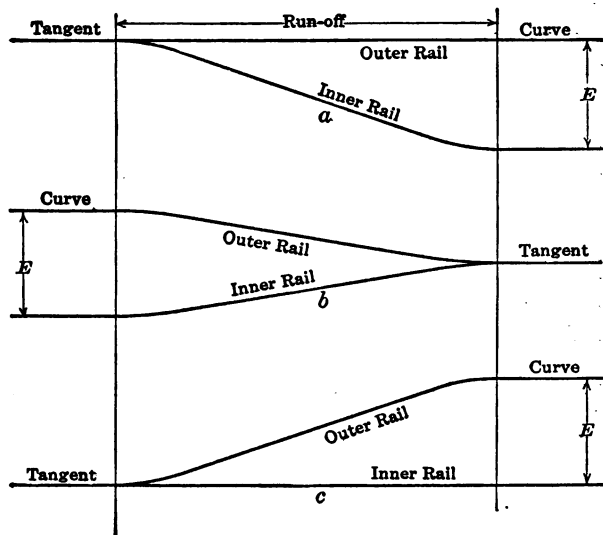


FIG. 2.—Showing slight vertical curves at ends of run-off.

instant before impact. If the beginning of the spiral is very flat, this angle is greatly reduced, and the shock is rendered ineffectual. But a spiral of uniformly varying degree, which provides the desired flatness at the beginning, would be of such great length that it would be discarded as impractical. It may now be seen that a spiral of uniformly varying degree does *not* meet all of the practical requirements of the ideally perfect easement curve.

THEORY

10. Form of Spiral. Considering the immediately foregoing statements and conclusions, it will readily be understood that the spiral best adapted to the practical working conditions is one in which there is a uniformly varying degree of curvature throughout the greater part of the length, where the rate of change in superelevation is constant and where all wheels are flanging the outer rail, while at the ends it is best to taper off the rate of change in degree of curvature. In short, to take a forward step toward the perfection of curve easements, the spirals should be spiraled. No authentic theory can completely cover this phase of the subject, as the governing factors are variable and indeterminate. The superelevation will not always be attained in precisely the same manner; on account of irregularities in the track, the wheels will not "track" symmetrically; and the inertia of a rocking car against being gradually tilted and steadied is a decidedly uncertain quantity. Yet, since these conditions are known to exist, it is highly desirable that we make allowance for them by arbitrary rules; especially so, when such allowance will not in any way interfere with the ease and rapidity of location.

The following rule for increasing the degree of curvature in the spiral has been chosen by the author as giving the closest possible approach to the ideal and practical curve easement:

Divide the spiral length into six equal parts; attain 5 per cent of the desired degree of curvature in the first part; in each of the next four equal parts of the spiral length attain 20 per cent of the desired degree; and in the remaining portion of the length increase the degree of curvature the remaining 15 per cent.

This rule provides for the vertical curves and makes additional allowance for bringing the flanges into contact with the outer rail upon entering the spiral. The middle four-sixths, or two-thirds, of the spiral is a portion of a cubic parabola, for the beginning of which has been substituted a section of a much flatter cubic parabola, and for the latter part of which has been substituted a section of a slightly flatter cubic parabola. We now have a curve easement

composed of a three-compound cubic parabola. At the points of compounding the adjacent curves have common radii and common tangents. At the zero point of the spiral, the P.S.,—"Point of spiral"—the radius is infinity. And at the sharper end, the P.S.C.—"Point of spiral and curve"—the radius and tangent are common to spiral and simple curve.

A curve easement laid out according to this method would conform, as nearly as can be ascertained, to the requirements of the actual conditions existing in track and rolling stock. The remaining requisite of an ideal curve easement is the facility of locating in the field.

The solution in the field of this compound cubic parabola for each curve that might be encountered is entirely beyond the limits of reason. In order to afford an easy method of locating curves in the field, the spiral will be solved and tables of deflection angles worked up which, by expanding, can be made to cover all possible cases. With the additional advantage of the possibility of expeditious location, "The Practical Railway Spiral" will fulfill all of the reasonable requirements.

11. Length of Spiral. The factor which should determine the minimum length of spiral is the rate of side tipping or velocity of rotation of the cars about the central line of the track while the train is entering or leaving a curve. The total amount of this tilting depends upon the superelevation of the outer rail. Since the spiral curve should coincide with the run-off or attainment of superelevation, the length of spiral required for the highest permissible speed on a given curve is determined by the amount of superelevation and the maximum allowable rate of side tilting of cars.

Several railways have adopted standards which, under certain conditions of speed and curvature, require a gain in superelevation of at least 2 ins. per second. These railways include the Chicago, Milwaukee & St. Paul, the Louisville & Nashville, the Cotton Belt Route, the Delaware & Hudson, the Memphis, Paris & Gulf, and the Pennsylvania. The custom that has been tested and approved by such systems as these must be recognized as a reasonable and worthy example for other roads to follow.

Therefore, let us choose 2 ins. per second as a safe rate of change in superelevation to be employed in finding the

minimum length of spiral for a given speed and superelevation.

Let the rate of tilting be 2" per second.

Then the time spent on the spiral is $\frac{1}{2}E$ seconds.

And the length of spiral, L , is $\frac{1}{2}E \times \frac{22}{15}V$, or,

$$L = \frac{11}{15}VE, \quad (3)$$

since the velocity in feet per second is $\frac{22}{15}V$. It might be supposed at first thought that the degree of curvature does not enter into this formula, but D and V determine E as per formula (1) or (2).

Table II has been derived from Table I, and formula (3). This table indicates the length of spiral required by a train whose velocity is the highest permitted by the given values of D and E . As in Table I, D varies from one degree to ten degrees and E varies by half inches up to 6 ins.

12. Practical Limitations. It will be seen, by inspecting the table, that the required length of run-off varies from 3 ft. for a ten-degree curve with a half inch superelevation to 413 ft. for a one-degree curve with $E=6''$. There are, however, certain practical limitations which throw these extremes out of consideration. A superelevation of more

TABLE II

SHOWING REQUIRED LENGTH OF SPIRAL CURVES AS DERIVED FROM TABLE I AND THE FORMULA, $L = \frac{11}{15}VE$

D = degree of curvature

Values of E .	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°
$\frac{1}{2}$ "	10	7	6	5	5	4	4	3	3	3
1	28	20	16	14	13	12	11	10	9	9
$1\frac{1}{2}$	52	37	30	26	23	21	20	18	17	16
2	80	56	46	40	36	32	30	28	26	25
$2\frac{1}{2}$	111	79	64	56	50	45	42	39	37	35
3	146	103	84	73	65	60	55	52	49	46
$3\frac{1}{2}$	184	130	106	92	82	75	70	65	61	58
4	225	159	130	112	101	92	85	80	75	71
$4\frac{1}{2}$	268	190	155	134	120	110	101	95	90	85
5	314	222	183	157	141	128	119	111	105	99
$5\frac{1}{2}$	363	257	220	183	164	148	137	128	121	115
6	413	292	239	207	185	169	156	148	138	131

than $3\frac{1}{2}$ " on a one-degree curve would be unusual. And a higher speed than seventy miles per hour should never be considered in determining the desired amount of superelevation, even on four-track systems where two tracks are used exclusively for fast trains. On the other hand, no matter how low the speed, the superelevation should never be less than 2 or 3 ins. on sharp curves nor numerically less than the degree of curvature on light curves, as otherwise the track will spread under heavy loading. Excluding extremes by these rules, there remains only that part of Table II included between the two heavy lines. Still further limitations would be made by many railroads which have set $3\frac{1}{2}$ ", 4", or 5" as the maximum superelevation and 4 or 5 as the maximum degree of curvature. The author feels confident that the lengths of spiral indicated in Table II are sufficiently long to insure the safe and smooth passing of trains. It must be remembered that these lengths are the minimum allowed under the stated conditions.

13. Further Considerations. There is no objection to greater lengths of spiral than is set forth in Table II, except the difficulty of fitting the curve to the country during location when long spirals are used; and, ever after, the well nigh impossible task of inducing section foremen to use excessively long run-offs when they have obtained satisfactory results with very short ones. However, in choosing the length of spiral, the advantages of straight track over curves must be considered.

When a railroad is being located, it is impossible to know, more than approximately, just what train speed may be expected on any given curve. Therefore, the length of spiral must be decided upon before all of the governing conditions have been determined. As a result, arbitrary rules, founded upon theory and the experience of others, must be adopted.

An inspection of Table II will show that a spiral length of approximately 140 ft., will cover almost every ordinary condition of speed and curvature without exceeding 2 ins. per second in change of superelevation. Above this distance the length increases very rapidly to nearly 300 ft. The latter values could be used advantageously in the prairie country where the highest speed in America is made or in any other territory where the alignment is light.

In mountainous country there frequently occurs a light curve between sharp ones. Under such conditions, the sharp curves limit the train speed as mentioned in Art. 5; and there will be very little superelevation and, consequently, very little need of spirals on the light curve. But in this case the alignment is easy and there would be no difficulty in introducing spirals 150 ft. in length.

It will also be seen from Table II that, when the maximum superelevation is used on all curves and the train velocity is limited thereby, the longest spirals are required by the flattest curves. Some railroads recognize this principle and place their longest spirals on the curves which permit the highest velocity. These facts are of sufficient importance to condemn the custom of many railways in omitting easements on all curves under two degrees.

There are as many objections to various lengths of spirals as there are to unnecessary compound curves. One serious objection to different lengths of spiral on the same stretch of track is the inability of section foremen to ascertain the exact position of the spirals unless the track is unusually well monumented. In this case the track will soon be misadjusted and the whole advantage of a well-lined easement is lost.

14. Choice of Length. By adhering to the foregoing reasoning, the reader will readily appreciate the advantages of employing a constant length of spiral for all curves of the same line. The author thoroughly believes that the use of spirals 150 ft. long on most lines and 300 ft. long on the high-speed lines would prove to be entirely satisfactory. With either length, the spiral could be run with 50-ft. chords, by setting alternate points in the 150-ft. spiral and all points in the longer one. There is far less chance for mistakes in chaining with chords of this length than with any other fraction of 100 ft. Using a constant length of spiral chord and becoming accustomed thereto would be a great help to all men on an engineering corps locating railroad lines.

The aforementioned spiral lengths, namely 150 ft., for the majority of lines and 300 ft. for the high-speed lines, have been chosen by the author as being the lengths best suited to the practical requirements of actual working conditions. However, in order to increase the elasticity of

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"The Practical Railway Spiral," additional lengths of 225 and 450 ft. have been chosen also. The latter lengths can be used by railways which prefer a rate of change in superelevation of less than 2 ins. per second, or on railways where various lengths of spiral are preferred. These lengths and the rate of change of degree of curvature given in Art. 10, are used in the development of the spiral in the following chapter.

CHAPTER III

SPIRAL DEVELOPMENT

In this chapter "The Practical Railway Spiral" is solved and put into shape for expeditious use. In carrying through the solution of the spiral certain rules and principles stated in the immediately following articles must be observed and understood.

GENERAL PRINCIPLES

15. Explanation of Terms. The spiral points, or ends of the six equal chords, will be designated in order P.S., 1, 2, 3, 4, 5, and P.S.C., as shown in Fig. 3. P.S. is the point of spiral or end of tangent, and P.S.C. is the point of spiral and curve or beginning of main curve. It will be considered that there is an auxiliary tangent at each spiral point and that all spiral points are connected by chords. As a matter of convenience, deflection angles from auxiliary tangents to points on the sharper part of the spiral will be termed "fore sights," as P.S. to 3, 2 to 5, Fig. 3, while deflections from these tangents to points back toward the main tangent will be known as "back sights," as 4 to P.S., 5 to 3, or P.S.C. to 2, etc. These deflections will be designated respectively P.S.-3, 2-5, 4-P.S., 5-3, P.S.C.-2, etc.

16. Sum of Fore Sight and Back Sight. The fore sight from one point to another plus the back sight from the second to the first is equal to the central angle between these two points. This is really a different manner of expressing the theorem "An exterior angle of a triangle is equal to the sum of the two opposite interior angles."

17. Corresponding Fore Sights and Back Sights Unequal. The fore sight from one spiral point to another is always less than the back sight from the second to the first.

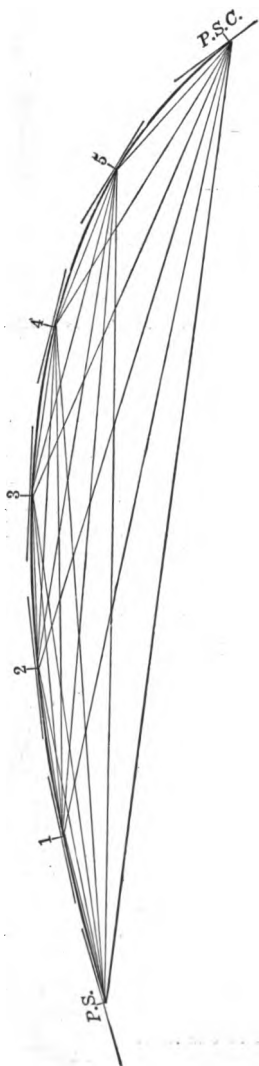


FIG. 3.—Showing auxiliary tangents at spiral points and long and short chords joining these points.

18. Tangents from Any Exterior Point. From Art. 17 it will be seen that the tangents to the spiral from any exterior point are of unequal length, the shorter being tangent to the point of shorter radius.

19. General Relation between Fore Sights and Back Sights. The sum of any number of successive fore sights $(1-2, +2-3 + \dots, +m-n)$ plus the sum of the corresponding back sights $(n-m + \dots, +3-2, +2-1,)$ is equal to the sum of the fore sight from the first point to the last and the back sight from the last to the first $(1-n, +n-1)$. This rule may be extended to cover any combination of fore sights and back sights.

20. Relation between Chord Length and Degree. As in simple curves, the chord length and the degree of curvature are inversely proportional to each other for constant deflection angles. When, as an example, a table of spiral fore sights and back sights has been worked up for a three-degree spiral using 50-ft. chords, the same table of angles will be correct for a six-degree spiral using 25-ft. chords, for a one-degree 30-minute spiral using 100-ft. chords, etc. If it is desired

to use 100-ft. chords on a six-degree spiral, the angles in this table must be multiplied by $6/3 \times 100/50 = 4$, and the new table will be correct for a spiral to a twelve-degree curve when 50-ft. chords are employed, etc. Therefore, one spiral completely worked out may, by expanding, be made applicable to all possible cases.

21. Equation of the Cubic Parabola. The general formula of a curve of uniformly varying radius is,

$$y = mx^3, \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

in which m is a factor determining the radius of curvature at any desired point. m is constant for any given curve.

22. Radius of the Cubic Parabola. From calculus, the radius of curvature, R , of any plane curve expressed in x and y coordinates is,

$$R = \frac{(1 + (dy/dx)^2)^{3/2}}{d^2y/dx^2}. \quad . \quad . \quad . \quad . \quad . \quad (5)$$

When $y = mx^3$, $dy/dx = 3mx^2$, and $d^2y/dx^2 = 6mx$. Then

$$R = \frac{(1 + 9m^2x^4)^{3/2}}{6mx}. \quad . \quad . \quad . \quad . \quad . \quad (6)$$

23. Relation between a and i . Let a be the deflection angle between the initial tangent and the long chord from

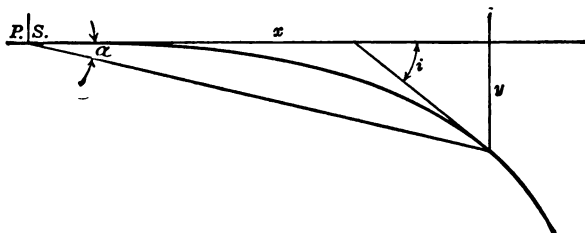


FIG. 4.—Showing a and i .

the P.S. to any point $x : y$, Fig. 4, and let i be the central angle between the same points.

$$\tan a = y/x = mx^2.$$

From calculus,

$$\tan i = dy/dx = 3mx^2.$$

Therefore,

$$\tan i = 3 \tan a. \quad (7)$$

24. Relation between R , x , and i . From formula (6),

$$R = \frac{(1 + 9m^2x^4)^{\frac{1}{2}}}{6mx}.$$

Substituting and reducing,

$$R = \frac{(1 + \tan^2 i)^{\frac{1}{2}}}{6mx^2/x} = \frac{x \left(\frac{\cos^2 i + \sin^2 i}{\cos^2 i} \right)^{\frac{1}{2}}}{2 \tan i} = \frac{x}{2 \tan i \cos^2 i}.$$

$$R = \frac{x}{2 \tan i \cos i \cos^2 i} = \frac{x}{2 \sin i \cos^2 i}.$$

$$x = 2R \sin i \cos^2 i.$$

$$x = R \sin 2i \cos i. \quad (8)$$

$$\sin 2i \cos i = x/R. \quad (9)$$

When R and i are known, x may be found directly from (8). When x and R are known, as in the problem at hand, i may be found by trial from (9). This method is very satisfactory for small angles, and the use of it for any others is unnecessary.

The foregoing equations and formulas, although somewhat crude, are absolutely exact, for no approximations have been made. They will be used only for solving the general spiral, from which all other spirals will be derived by direct proportion. They need never be referred to in the field as practical working formulas will be developed later.

DESIGN OF GENERAL SPIRAL

Let us now design the general spiral which will be absolutely exact, and from which tables of deflection angles may be calculated for all other spirals. For convenience, let the spiral be 600 ft. in length—6-100-ft. chords—and let the degree of curvature increase from zero to three degrees.

According to the rule for the increase of degree stated in Art. 10, the degree of curvature, expressed in minutes, at the spiral points is as follows:

Point on spiral.....	P.S.	1	2	3	4	5	P.S.C.
Per cent of degree.....	0	5	25	45	65	85	100
Degree in minutes.....	0	9'	45'	81'	117'	153'	180'

25. Equations and Dimensions of First Curve. At point 1 $x=100$ ft., $D=9'$, and $R=38,197$ ft.

$$\log x = 2.00000,$$

$$\log R = 4.58203,$$

$$\log \sin 2i + \log \cos i = 7.41797.$$

By inspecting the tables of angle functions, it is quickly seen that $2i$ is about $9'$, and that $\log \cos i = 0.00000$. Therefore, $\log \sin 2i = 7.41797$. Then $i = 4.5'$ is the angle subtended by the first chord.

It follows that a , the deflection angle, is $1.5'$.

$$y = 100 \tan 1.5' = 0.044.$$

The deflection angle is so small that the assumption $x=100$ is exact.

So then, at point 1, $x=100$, $y=0.044$, $i=0^\circ 4.5'$, $R=38,197$, and $D=0^\circ 09'$.

The equation of the curve is

$$y = \frac{440}{(10)^{10}} x^3 \quad . \quad . \quad . \quad . \quad . \quad (10)$$

At point 1 the first curve must be compounded with the second so that there is a common tangent and a common radius.

26. To Find the Equation of the Second Curve, $y' = m'x'^2$. The degree of curvature varies directly as the distance from the origin and increases 36 minutes in each hundred feet. Therefore, at $9/36 \times 100 = 25$ ft. from the origin the degree is the desired value, and the origin is 25 ft. back from point 1 of the spiral. This curve extends from point 1 to point

5, consequently, the points of interest in it are 25, 125, 225; 325, and 425 ft. from the origin. At point 5, or 425 ft. from the origin of this curve, D is 153 minutes and R is 2247 ft. Trial calculations show that at this point $x' = 424.64$ ft. Then, according to formula (6),

$$R = \frac{(1 + 9m'^2(424.64)^4)^{\frac{1}{2}}}{6m' \cdot 424.64}$$

Solving by trial it is found that $\log m'$ is $3.24820 - 10$. And the logarithmic equation of the second curve is

$$\log y' = 3.24820 - 10 + 3 \log x'. \quad \dots (11)$$

27. To Find the Angle which the Axes of the Second Curve Make with Those of the First. Since the deflection angle for the first 25 ft. of this curve is so small, x' may be taken as 25 ft. At $x' = 25$, $\tan i' = 3m'x'^2$.

$$\begin{aligned} \log 3 &= 0.47712; \\ \log m' &= 3.24820 - 10; \\ 2 \log 25 &= 2.79588; \\ \hline \log \tan i' &= 6.52120 - 10; \\ i' &= 0^\circ 01' 08.5''. \end{aligned}$$

At point 1

$$\begin{aligned} i &= 0^\circ 04' 30''; \\ i' &= 0^\circ 01' 08.5''; \\ \hline i - i' &= 0^\circ 03' 21.5''. \end{aligned}$$

The axes of the second curve make the angle $0^\circ 03' 21.5''$ with those of the first when there is a common tangent at point 1, where $x = 100$ and $x' = 25$. This angle must be *added* to all tangent and chord slopes of the second curve in order that these functions may be referred to the main axes, the straight track produced and the perpendicular through the P.S.

28. Solving Second Curve with Reference to Its Own Axes. The solution will now proceed by finding the slopes of the 100-ft. chords and of the tangents at the chord points with reference to the axes of this curve. These slopes will then be referred to the main axes by adding the angle 0°

03' 21.5". From the new chord slopes coordinates will be computed, and from these coordinates all other angles will be calculated.

It is unnecessary here to go through with the simple, though long, calculations by which the coordinates of the spiral points were determined. The resulting coordinates are:

Spiral Point.	x'	y'
1	25.00	0.0028
2	125.00	0.3459
3	224.99	2.0167
4	324.91	6.0740
5	424.64	13.5600

From these values of x' and y' the slopes of the 100-ft. chords were found. As an example, the tangent of the slope of the chord 4 to 5 is

$$\frac{13.560 - 6.074}{424.64 - 324.91} = \frac{7.486}{99.73}$$

Log tan slope = 8.87542, and the desired angle is 4° 17' 33.7".

The chord slopes thus found are:

Chord	Slope
1 to 2	0° 11' 47.7"
2 to 3	0 57 26.4"
3 to 4	2 19 30.4
4 to 5	4 17 33.7

We must also know the slopes of the tangents to the curve at the different spiral points. This is easily and quickly done by means of the equation

$$\tan i' = 3m'x'^2.$$

As an example, consider the auxiliary tangent at point 4. Here $x' = 324.91$. and $\log \tan i'$ is the sum of $\log 3$, $\log m'$, and two times $\log 324.91$ and is 8.74885 - 10. Then i' is 3° 12' 36.1".

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The tangent slopes thus found are:

Point	Slope
1	0° 01' 08.5"
2	0 28 32.2
3	1 32 25.7
4	3 12 36.1
5	5 28 19.9

The foregoing slopes of chords and tangents will be referred to the main axes by the addition of 0° 03' 21.5".

This curve is compounded with the third at spiral point 5 where there is a common tangent and a common radius.

29. To find the Equation of the Third Curve, $y'' = m''x''^3$. This curve is a 100-ft. section of a cubic parabola whose degree of curvature is 153' at point 5 and 180' at the P.S.C. In 100 ft. D is increased 27', and the origin is $180/27 \times 100$ or $666\frac{2}{3}$ ft. back from the P.S.C. It is found by trial solution of the previously stated formulas that x'' is 665.5 and $\log m''$ is $3.13914 - 10$. And the logarithmic equation of the third curve is

$$\log y'' = 3.13914 - 10 + 3 \log x''. \quad \dots (12)$$

30. To Find the Angle which the Axes of this Curve Make with the Main Axes. At spiral point 5, $x'' = 566.7$, nearly, and $\tan i'' = 3m''x''^2$. Solving for i'' , we find that i'' is 7° 33' 38.1". The slope of the tangent at this point is

$$5^\circ 28' 19.9'' + 0^\circ 03' 21.5'' = 5^\circ 31' 41.4''$$

$$7 \quad 33 \quad 38.1$$

$$5 \quad 31 \quad 41.4$$

$$2 \quad 01 \quad 56.7$$

The axes of the third curve make the angle 2° 01' 56.7" with the main axes. This angle must be *subtracted* from the slopes of the chord 5 to P.S.C. and of the tangent at the P.S.C. in order that they may be referred to the main axes.

31. Solving the Third Curve with Reference to Its Own Axes. By the methods explained in the solution of the second curve, it is found that the slope of the sixth chord is 8° 56'

07.3'', and the slope of the tangent at the P.S.C. is $10^{\circ} 22' 22.8''$. From these angles must be subtracted $2^{\circ} 01' 56.7''$.

32. Summary of the Slopes of the Tangents and the 100-ft. Chords. Referring the chords and tangents thus found to the main axes by the addition or subtraction of the specified angles we have the following slopes:

Chord.	Slope.	Tangent.	Slope.
P.S. to 1	$0^{\circ} 01' 30''$	at 1	$0^{\circ} 04' 30''$
1 to 2	0 15 09	at 2	0 31 54
2 to 3	1 00 48	at 3	1 35 47
3 to 4	2 22 52	at 4	3 15 58
4 to 5	4 20 55	at 5	5 31 41
5 to P.S.C.	6 54 11	at P.S.C.	8 20 26

33. Coordinates of Finished Spiral. These chord slopes are now used in finding the coordinates of the finished spiral. The slope of chord P.S. to 1 is $0^{\circ} 01' 30''$. Therefore the ordinate of point 1 is $100 \sin 0^{\circ} 01' 30''$, and is 0.044 ft. And the abscissa of point 1 is $100 \cos 0^{\circ} 01' 30''$, and is 100.00 ft. Slope of chord 1 to 2 is $0^{\circ} 15' 09''$. The ordinate of point 2 is $0.044 + 100 \sin 0^{\circ} 15' 09''$, and is 0.485 ft. And the abscissa of point 2 is $100 + 100 \cos 0^{\circ} 15' 09''$, and is 200 ft. Following through the whole spiral in this manner all of the coordinates are found. They are as follows:

Point.	x	y
P.S.	0.000	0.000
1	100.000	0.044
2	200.000	0.485
3	299.985	2.254
4	399.897	6.409
5	499.607	13.991
P.S.C.	598.882	26.010

34. To Find All of the Deflection Angles of the Spiral. These angles are found from the slopes of the tangents and those of the many long and short chords of the spiral. The slopes of chords connecting other than adjacent spiral points

are found by means of the coordinates of the ends. Consult Arts. 15 to 19.

The deflection angle from one point to another is the difference between the slope of the auxiliary tangent at the first point and the slope of the chord between the two points in question.

At the P.S. the tangent is the main axis with zero slope. The slope of chord P.S. to 1 is $0^{\circ} 01' 30''$. Therefore, deflection P.S.-1 is $0^{\circ} 01' 30''$. The slope of the tangent at 1 is $0^{\circ} 04' 30''$, and the slope of chord P.S. to 1 is $0^{\circ} 01' 30''$. Therefore, deflection 1-P.S. is $0^{\circ} 03' 00''$. The slope of chord 1 to 2 is $0^{\circ} 15' 09''$, and the slope of the tangent at 2 is $0^{\circ} 31' 54''$. Therefore, we have deflection 2-1 is $0^{\circ} 31' 54'' - 0^{\circ} 15' 09'' = 0^{\circ} 16' 45''$, and deflection 1-2 is $0^{\circ} 15' 09'' - 0^{\circ} 04' 30'' = 0^{\circ} 10' 39''$.

In like manner, the slope of chord 2 to 3 is $1^{\circ} 00' 48''$, and of the tangent at 3 is $1^{\circ} 35' 47''$. Consequently, 2-3 is $1^{\circ} 00' 48'' - 0^{\circ} 31' 54'' = 0^{\circ} 28' 54''$, and 3-2 is $1^{\circ} 35' 47'' - 1^{\circ} 00' 48'' = 0^{\circ} 34' 59''$. The remaining fore sights and back sights between adjacent points are found in the same manner.

The finding of deflection angles between other than adjacent points differs from the foregoing only in the necessity of first finding the slope of the chord joining these points. As an example, let us find deflections 2-4 and 4-2. The coordinates of point 2 are 200 and 0.485, and of point 4 are 399.897 and 6.409. The tangent of the slope of chord 2 to 4 is

$$\frac{6.409 - 0.485}{399.897 - 200} = \frac{5.924}{199.897}$$

Solving by logarithms

$$\log 5.924 = 0.77261$$

$$\begin{array}{r} \log 199.897 = 2.30080 \\ \log \tan \text{slope} = 8.47181 - 10 \end{array}$$

The desired slope is $1^{\circ} 41' 51''$. The slope of the tangent at 2 is $0^{\circ} 31' 54''$, and of the one at 4 is $3^{\circ} 15' 58''$. Then deflection 2-4 is $1^{\circ} 41' 51'' - 0^{\circ} 31' 54'' = 1^{\circ} 09' 57''$, and deflection 4-2 is $3^{\circ} 15' 58'' - 1^{\circ} 41' 51'' = 1^{\circ} 34' 07''$.

In like manner all other deflections are determined. The single example given is sufficient explanation.

All of the fore sights and back sights thus found are assembled in Table III.

TABLE III

DEFLECTIONS TO THE NEAREST SECOND FOR A 600-FT.
SPIRAL TO A THREE DEGREE CURVE

$DL = 1800$

$I = 8^{\circ} 20' 26''$

	P.S.	1	2	3	4	5	P.S.C.
S.	P.S.	0° 01' 30"	0° 08' 20"	0° 25' 50"	0° 55' 05"	1° 36' 15"	2° 29' 13"
1	0° 03' 00"	1	0 10 39	0 33 29	1 08 27	1 55 26	2 54 16
2	0 23 34	0 16 45	2	0 28 54	1 09 57	2 02 58	3 07 48
3	1 09 57	0 57 48	0 34 59	3	0 47 05	1 46 07	2 56 52
4	2 20 53	2 03 01	1 34 07	0 53 06	4	1 04 57	2 21 35
5	3 55 26	3 31 45	2 56 49	2 09 47	1 10 46	5	1 22 30
C.	5 51 13	5 21 40	4 40 44	3 47 47	2 42 53	1 26 15	P.S.C.

35. Explanation of Table III. This table is patterned after others of the same style, the originator of which is unknown to the author. This form of table affords a very convenient and systematic arrangement for spiral deflection angles, and is used by a great many railways. With the transit at the P.S., the deflections to the different spiral points are found in the first horizontal line and under the corresponding points in the head line. When the instrument has been moved to any other point, the deflections from that point will be found in the horizontal line through that point at the left edge of the table. The numbers of the spiral points in the diagonal line are merely placed there as a matter of convenience, there being no deflection angles for such spaces. To the left of this diagonal line are the "back sights" and to the right are the "fore sights." When a deflection angle is designated by the numbers of the points in question, as 2-5, the required angle is found in the horizontal line through the first-named number, as 2, and in the column headed by the last-named number, as 5. The desired angle is fore sight or back sight accordingly as the first-named point is numerically smaller or larger than the other. (Thus, 2-5 is

a fore sight and is found in the horizontal line 2 and column 5. It is $2^{\circ} 02' 58''$.

As a further explanation, suppose that when locating the spiral a slight hill is encountered at point 4 necessitating the setting up of the transit at points P.S., 4, and P.S.C. When the transit is at P.S., the deflections to points 1, 2, 3, and 4 are respectively $0^{\circ} 01' 30''$, $0^{\circ} 08' 20''$, $0^{\circ} 25' 50''$, and $0^{\circ} 55' 05''$. When the transit has been moved to point 4, it is necessary to turn off such an angle, before taking a back sight onto the P.S., that, when the vernier afterwards reads zero, the telescope will point along the auxiliary tangent through point 4. This angle is the deflection 4-P.S. and is $2^{\circ} 20' 53''$. Deflections 4-5 and 4-P.S.C. are turned off after the telescope has been reversed. These are respectively $1^{\circ} 04' 57''$ and $2^{\circ} 21' 35''$. The transit may then be advanced to the P.S.C. Here the back sight is P.S.C.-4, and is $2^{\circ} 42' 53''$. When the vernier reads zero, the telescope is in the tangent through the P.S.C., and the simple curve may be begun. The sum of all the fore sights and back sights onto the transit points equals the total central angle as per Art. 19. A spiral in rough country may require the use of any or all of the intermediate spiral points as transit points. And it is necessary, therefore, to have all of the deflections in Table III in convenient shape, although it is impossible to use more than a small proportion of these angles in any one spiral.

As an aid to the memory, it might be considered that the transit is set up on the table itself and on the point, in the diagonal line mentioned before, denoting the transit point on the spiral. Then the horizontal line through the transit represents the spiral. The numbers in this line are all the angles that can be read from the point in question, those on the left being "back sights" and those on the right being "fore sights."

The angles in Table III are those for a 600-ft. spiral to a three-degree curve. As stated in Art. 20, these deflections are correct for a 300-ft. spiral to a six-degree curve, for a 150-ft. spiral to a twelve-degree curve, etc. These angles must be divided by 4 to obtain the deflections for a 150-ft. spiral to a three-degree curve. Then these new deflections will also be correct for a 300-ft. spiral to a $1^{\circ} 30'$ curve.

Following this principle, the deflections in Table III have been extended to include 150-ft. spirals for curves whose degree of curvature varies by half degrees up to six degrees, then by single degrees up to twelve degrees, and then by two degrees up to twenty degrees. These deflections are correct for 300-ft. spirals for curves whose degree of curvature is one-half those mentioned for the 150-ft. spirals. And further, these deflections are correct for 450 and 225 ft. spirals when the degree of curvature is, respectively, one-third and two-thirds that of the 150-ft. spirals. As stated in Art. 14, these four lengths of spiral, with their deflection angles and other functions, have been worked out and put into practical shape for convenient use with any ordinary degree of curvature. In all there are twenty-two different degrees of curvature for each of the four spiral lengths, which is sufficient for all curves ordinarily encountered. These deflections are given to the nearest half minute in Tables IV to XXV.

36. Extending the Tables. To find the deflection for a spiral of length L for a curve of degree D , when D and L are not given in the tables: Any desired deflection equals the corresponding deflection in Table III multiplied by $D/3 \times L/600$.

Any deflection = $DL/1800 \times$ the corresponding deflection in Table III. (13)

As an example, in computing Table X, $D=5^\circ$ and $L=150$, or $D=2^\circ 30'$ and $L=300$, etc. In any case $DL=750$ and $750/1800$ is $5/12$ and all angles in Table III were multiplied by $5/12$. These angles were then reduced to the nearest half minute, as thirty seconds is ordinarily the smallest difference of angle indicated by a transit vernier.

The other functions of the spiral which are required for practical use in the field or drafting-room are shown in Fig. 5. In this figure BK is the tangent which is connected by the spiral BC to the simple curve CD . O' is the P.C. of the simple curve $O'CD$ when it is connected without a spiral to the parallel tangent $B'O'$. And F is the center of the simple curve. CH is perpendicular to FO' . The desired quantities are d , the distance BO or the abscissa of O' ; p ,

the distance OO' or the ordinate of O' ; x , the distance BK or abscissa of C ; and y , the distance KC or ordinate of C . x is the sum of the abscissae of the several chords. And

$$y = x \text{ multiplied by tan of deflection P.S.-P.S.C.} \quad (14)$$

$FC=FO'=R$, the radius of the simple curve.

$$p = OO' = OH - O'H = KC - O'H = y - O'H.$$

$$O'H = FO' - FH = R - R \cos I.$$

$$p = y - (R - R \cos I).$$

$$p = y + R \cos I - R. \quad . \quad . \quad . \quad (15)$$

$$d=BK-OK=x-CH.$$

$$CH = R \sin I.$$

$$d = x - R \sin I \quad . \quad . \quad . \quad . \quad . \quad (16)$$

By Art. 16, $I = P.S. - P.S.C. + P.S.C. - P.S.$

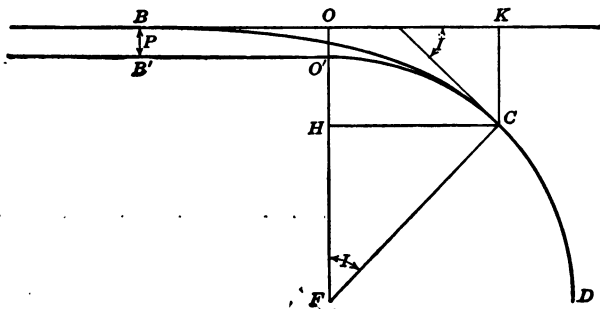


FIG. 5.—Showing functions of any spiral.

By means of formulas (14), (15), and (16) the necessary functions were calculated for all of the spirals given in Tables IV to XXV for the four different lengths of spiral.

37. Working Formulas. None of the foregoing formulas need ever be referred to except when a spiral not given in the tables is desired.

When the surveying party is at work on line, the known factors of a curve are the station of the P.I., M in Fig. 6, and the central angle, A , being determined by transit and chain. The degree of curvature and the spiral to be used

have already been decided upon. It is now necessary to find T , the distance BM in Fig. 6 and the distance CU or length, L , of the simple curve. In Fig. 6, B , O , and C are

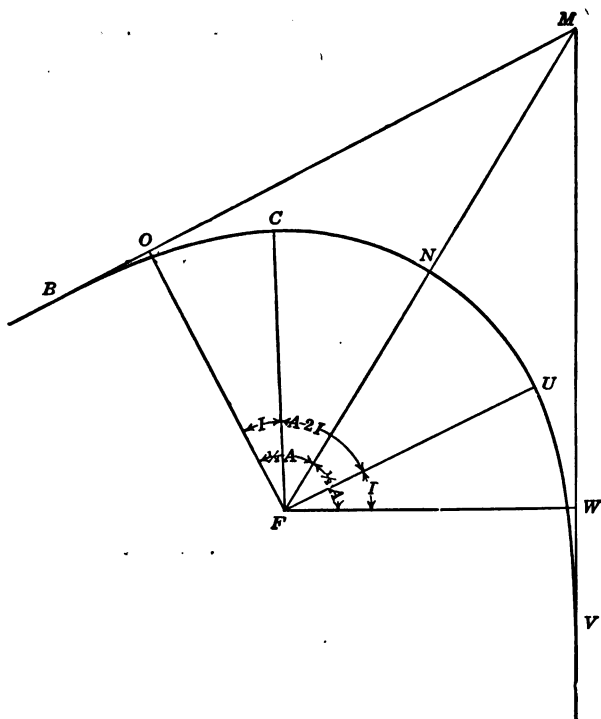


FIG. 6.—Showing curve with tangents and spirals as it appears in the field.

the same as in Fig. 5, and V , W , and U are the corresponding points on the other end of the curve.

$$T = BM = BO + OM.$$

$$BO = d \text{ (found in the table).}$$

$$OM = FO \tan OFM = (R+p) \tan \frac{1}{2}A.$$

$$T = d + (R+p) \tan \frac{1}{2}A. \quad \dots \dots \dots (17)$$

$\log (R+p)$ is found in the table.

The distance CU or length, L , of the simple curve subtends the central angle $A-2I$. D is the degree of curvature. And CU in feet is

$$L = 100 \frac{A-2I}{D} \dots \dots \dots (18)$$

The external distance, Q , or MN in Fig. 6, is occasionally desired.

$$Q = MN = FM - FN = FM - R.$$

$$FM = FO / \cos \frac{1}{2}A.$$

$$FO = (R+p).$$

$$Q = (R+p) / \cos \frac{1}{2}A - R. \dots \dots \dots (19)$$

The quantity $(R+p) / \cos \frac{1}{2}A$ is most easily found by logarithms.

Formula (19) may be expressed in different form, thus:

Subtract p from both members of equation (19):

$$Q - p = (R+p) / \cos \frac{1}{2}A - (R+p).$$

$$Q - p = (R+p) \sec \frac{1}{2}A - (R+p).$$

$$Q - p = (R+p)(\sec \frac{1}{2}A - 1) = (R+p) \operatorname{exsec} \frac{1}{2}A.$$

$$Q = (R+p) \operatorname{exsec} \frac{1}{2}A + p. \dots \dots \dots (20)$$

The equation for Q is given in forms (19) and (20) for the simple reason that tables of external secants and versed sines are more common than are tables of secants.

38. Summary of Nomenclature. There follows a list of all characters employed in the preceding pages, and also of a few self-evident initials that will be used in the curve notes on the following pages:

A = Total angle of curve.

I = Central angle of spiral.

D = Degree of curvature.

R = Radius of curvature.

L = Length of spiral or simple curve.

T = Tangent distance or distance from P.S. to P.I.

d = Abscissa of P.C. of spiraled curve produced.

p = Ordinate of P.C. of spiraled curve produced.

x = Abscissa of P.S.C.

y = Ordinate of P.S.C.

Q = External of spiraled curve.

P.C. = Point of curve when no spiral is used.

P.S. = Point of spiral.

P.S.C. = Point of spiral and curve.

P.I. = Point of intersection of tangents produced.

P.C.S. = Point of curve and spiral.

P.T. = Point of tangent.

P.O.T. = Transit point on tangent.

P.O.S. = Transit point on spiral.

P.O.C. = Transit point on curve.

E = Superelevation of outer rail in inches.

V = Train velocity in miles per hour.

39. Examples. By way of further illustration, the notes for a three-degree curve within 150-ft. spirals are here given in their simplest form. The curve was run from the first end as far as the P.C.S. and the second spiral was "backed in" from the P.T., which was previously set from the P.I. Fifty-foot chords are represented in the spiral notes as it is

PAGE OF TRANSIT BOOK

Stations.	Align- ment.	Deflection Angles.	Back Sight Angles.	Functions.	Courses.
1663 +94.0	P.O.T.	.....	.....	.....	....
1663	...	.....	.....	.....	....
1682 +48.4	P.T.	.....	0° 00'	.....	....
1661 +98.4	...	.....	0° 02'	$I = 2^\circ 05'$	....
1661 +48.4	...	.....	0° 14'	$L = 150$	....
1660 +98.4	P.C.S.	7° 40.5'	0° 37'	.....	....
1660	...	6° 12'	.....	$A = 19^\circ 31'$	....
1659	...	4° 42'	.....	$A - 2I = 15^\circ 21'$	....
1658	...	3° 12'	.....	$L = 511.7$	....
1657	...	1° 42'	.....	P.I. = 1658 +45.8	....
1656	...	0° 12'	.....	$T = 409.1$	....
1655 +86.7	P.S.C.	0° 37'	1° 28'	.....	....
1655 +36.7	...	0° 14'	.....	$I = 2^\circ 05'$	....
1654 +86.7	...	0° 02'	.....	$L = 150$	....
1654 +36.7	P.S.	0° 00'	.....	$D = 3^\circ 00'$	left
1654	...	.....	.....	.....	(or right)

not necessary to use so short a chord as 25 ft., although all spiral points may be set when desired. The omitting of alternate points in a short spiral in no manner injures the effects of a curve easement, as the points which are really located are sufficient to give almost the exact alignment desired. In the final location on the finished roadbed all points are set.

In difficult country, where intermediate hubs are required, the deflection angles are different, but the work is no more complicated. Suppose that the foregoing curve were run in where the country required the placing of the transit at intermediate points in both spirals and also in the simple curve. We will also suppose that the entire curve was run without previously setting the P.T. The notes might then appear as follows:

PAGE OF TRANSIT BOOK

Stations.	Align- ment.	Deflection Angles.	Back Sight Angles.	Functions.	Courses.
1663+94.0	P.O.T.	.....	.....	.....	.....
1663	...	.....	.....	.....	.....
1662+48.4	P.T.	0° 06'	0° 02'	.....	.....
1661+98.4	P.O.S.	1° 10'	0° 47'	$I = 2^\circ 05'$	.....
1661+48.4	...	0° 40.5'	.....	$L = 150$	.....
1660+98.4	P.C.S.	7° 40.5'	4° 28.5'	.....	.....
1660	...	6° 12'	.....	$A = 19^\circ 31'$	.....
1659	...	4° 42'	.....	$A - 2I = 15^\circ 21'$	.....
1658	P.O.C.	3° 12'	0° 00'	$L = 511.7$	.....
1657	...	1° 42'	.....	$P.I. = 1658 + 45.8$	.....
1656	...	0° 12'	.....	$T = 409.1$	.....
1655+86.7	P.S.C.	0° 35.5'	0° 40.5'	.....	.....
1655+36.7	P.O.S.	0° 14'	0° 35'	$I = 2^\circ 05'$	.....
1654+86.7	...	0° 02'	.....	$L = 150$	.....
1654+36.7	P.S.	0° 00'	.....	$D = 3^\circ 00'$	left
1654	...	.....	.....	.....	(or right)
1653	...	.....	.....	.....	.....
1652	...	.....	.....	.....	.....
1651	P.O.T.	.....	.....	.....	.....
1650	...	.....	.....	.....	.....
1649	...	.....	.....	.....	.....

40. Explanation of the Tables. All possible information concerning the tables of deflection angles has been given at

various places in the preceding pages. But it is advisable to give here a brief explanation of Tables IV to XXV.

Each table gives all deflections for all possible spirals in which the product of D and L equals the stated amount. There is a certain value for the product of D and L for each table. The value of I is the sum of the fore sight and back sight between the P.S. and P.S.C. In each table the values of I and the product of D and L are given in the heading. These quantities are constant for all spirals for which the table in question gives the deflections.

In connection with the deflections are given the corresponding values of the functions D , x , y , d , p , and $\log (R+p)$ for each of the spiral lengths, 150 ft., 225 ft., 300 ft., and 450 ft. The values of D are, of course, inversely proportional to the corresponding values of L . These dimensions of the spiral are given in the table of "Functions." In this table, each horizontal line gives all of the functions for a certain spiral.

41. Using a Spiral that is Not Tabulated. When running in a curve, with 150-ft. spirals, of an odd degree for which no table is given, interpolate for x between the values given in the preceding and succeeding tables. I , the spiral angle, and all necessary deflections may be found by multiplying the corresponding angles in Table III by $\frac{1}{12}D$. Only a few of these deflections will be necessary, and only those required as fore sights and back sights onto transit points need be found accurately. d is found by the formula,

$$d = x - R \sin I.$$

And y equals x multiplied by the tangent of the deflection P.S.-P.S.C. Then p may be found by the formula,

$$p = y + R \cos I - R.$$

A similar method of procedure is employed in finding the functions of any other given length of spiral for an odd degree of curvature.

When both D and L are quantities not to be found in the tables, their product divided by 1800 is the factor by which the angles in Table III must be multiplied. Then x is figured by simple proportion and interpolation. And the other functions are determined as before.

42. x Proportional to L . It will be seen in the tables of functions that the values of x are proportional to the corresponding L 's. This is as it should be so long as the angles remain the same. However, as a check on the work, the x 's were found by independent calculations. As the angle increases, the difference between x and L increases very slowly, and the interpolation for any x is a simple mental problem.

43. d Nearly Proportional to L . It will be noticed that d is nearly constant for any given length of spiral, no matter what the degree of curvature may be. This is easily understood when we reason as follows:

$$\sin \frac{1}{2}D = 50/R. \quad (\text{Fundamental principle of curvature.})$$

$$R = 50/\sin \frac{1}{2}D.$$

For 150-ft. spirals,

$$I = D(0^\circ 41.7'). \quad (\text{Previously explained.})$$

Then

$$d = x - \frac{50}{\sin \frac{1}{2}D} \sin D(0^\circ 41.7'),$$

$$d = x - \frac{50}{\sin \frac{1}{2}D} \sin 0.695D.$$

So far there have been no approximations.

Now, small angles vary as their sines. And

$$d = x - 50 \frac{\sin 0.695D}{\sin 0.5D} = x - 69.50.$$

$d = 150 - 69.50 = 80.50$ ft. is true for the very flattest spirals. When the spiral angle, I , increases, $x - d$ falls below 69.50, but the value of x also decreases so that the value of d changes very slowly. By special calculations it is found that, *when the exact value of I is used*, the value of d to the nearest tenth of a foot is as follows:

150-FOOT SPIRALS.			300-FOOT SPIRALS		
D		d	D		d
Under	7°	80.5	Up to $3^\circ 30'$		161.0
7°	to 11°	80.4	$3^\circ 30'$	to 6°	160.9
11°	to 14°	80.3	6°	to 8°	160.8
14°	to 18°	80.2	8°	to 9°	160.7
18°	to 20°	80.1	9°	to 10°	160.6

225-FOOT SPIRALS			450-FOOT SPIRALS		
<i>D</i>		<i>d</i>	<i>D</i>		<i>d</i>
Under	7°	120.7	Under	2° 30'	241.5
7°	to 9° 30'	120.6	2° 30'	to 4°	241.4
9° 30'	to 12°	120.5	4°	to 5°	241.3
12°	to 14°	120.4	5°	to 6°	241.2
			6°	to 7°	241.1

It must be remembered that the foregoing values of d are to be used only when the exact value of I has been figured and the length of simple curve determined therefrom. The disagreement of d in the various tables is caused by taking I at the nearest half minute instead of at the nearest second.

As an illustration, consider the 4° 00' curve with the 150-ft. spiral. The exact value of I is 2° 46' 49'', and the value of $x-d$ calculated therefrom is 69.49. In shaping the notes for transit use, I was taken 2° 47', the nearest half minute. Then $R \sin I$ is 69.57 ft., and the difference is 0.08 ft.

With a certain total angle, A , increasing I decreases $A - 2I$, and likewise the length of simple curve. But the length of spiral remains unchanged. So, then, by decreasing the total length of curve we also decrease the tangent distance. This change in T is the same as the small change in d , namely, 0.08 ft. in each tangent for the case sighted. This is slightly greater than the decrease in length on each end of the curve. For 0° 00' 11'' is 0.00306 of one degree, and the length of the arc of a four-degree curve containing this angle is 0.076 ft.

It will be understood that when using the deflections found in the tables, the corresponding d must also be used.

CHAPTER IV

REVISION

By revision is meant simply the introducing of spirals into alignment that has been previously located with simple curves and tangents. An entire change of the location along the same general route is frequently, and correctly, termed revision work. But this is in the form of new location which has been fully treated. In this chapter we will consider only the case of introducing easements without altering the tangents and without making serious changes in the position and alignment of the curves.

44. To Revise without Altering the Degree of Curvature. This is accomplished by re-figuring the curve, using the same central angle and the same radius, but the spiral offset, p , is taken into consideration. The perpendicular distance from the tangents to the center of the simple curve is now $(R+p)$ instead of R . And the external distance is increased by $p/\cos \frac{1}{2}A$. Throughout its entire length the curve is thrown toward the center and is, therefore, shortened to such an extent as to necessitate the cutting of the steel when the central angle is large.

This method is most desirable on summits and at the bottoms of sags. Owing to the greater speed of down-grade trains and the consequent application of brakes, steel generally creeps down grade. At least, it creeps down hill in the direction of the heavier traffic more rapidly than it creeps up hill in the same direction. Consequently, the joints are pulled open on the summits and are crowded together in the sags. When revising, in the former case it is desirable that the line be shortened. And in the latter case sufficient steel can be cut away to allow increased expansion in the joints.

45. To Insert Spirals by Compounding Near the Ends of Curve. When the central angle is large and a great change in alignment is undesirable, the ends of the curve may be sharpened to allow for the spiral offset, p . This is done by introducing a short length of curve whose degree is slightly greater than that of the original curve. In this case it is necessary to find the point of compounding so that the spiral and short length of sharper curve will have exactly the same angle that was previously subtended by the replaced arc of the original curve. Let R and D be the radius and degree of the main curve, and R' and D' the corresponding functions

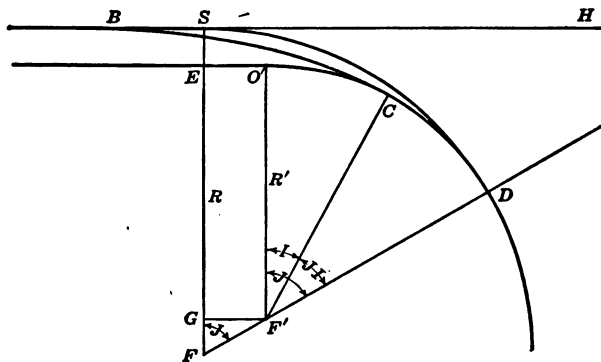


FIG. 7.—Showing curve spiraled by first compounding near the ends to a sharper curve.

of the sharper curve at the ends, to which the spirals are to be added. D and D' should not differ by more than thirty minutes for light curves and 150-ft. spirals nor more than fifteen minutes for 300-ft. spirals. Indeed, this difference will be sufficient for all degrees of curvature up to five or six degrees. For sharper curves $D' - D$ should be greater.

In Fig. 7 SD is the original curve which is to be compounded at some point D with a curve of degree D' , which, in turn, is connected to the tangent by the spiral BC . O' is the P.C. of this curve produced.

By consulting the table, the value of p is found.

In Fig. 7 $F'G$ is drawn parallel to the tangent. F and F' are the centers of the two curves.

$$SF = R.$$

$$GE = F'O' = R'.$$

$$SE = p.$$

$$FF' = R - R'.$$

$$FG/FF' = \cos J. \quad FG = (R - R') \cos J.$$

$$FG + SE = R - R'.$$

$$(R - R') \cos J + p = (R - R'). \quad \cos J + \frac{p}{R - R'} = 1.$$

$$\frac{p}{R - R'} = 1 - \cos J$$

$$\cos J = \frac{R - R' - p}{R - R'}. \quad (21)$$

Formula (21) gives the total angle involved in the revision. The length of the old curve up to the P.C.C. is

$$SD = J/D \times 100. \quad (22)$$

And the length of the sharper curve between the P.C.C. and the P.S.C. is

$$DC = \frac{J - I}{D'} \times 100. \quad (23)$$

BC is the length chosen in selecting the spiral.

If a check on the work is desired, proceed in this way:

Produce FD until it cuts the tangent at H .

$$SH = R \tan J.$$

$$BH = (R' + p) \tan J + d.$$

$$BS = BH - SH.$$

If so desired, the P.S., *B*, may be established and the spiral run in from the tangent.

As an example, let us compound a five-degree curve to a $5^{\circ} 30'$ and insert a 150-ft. spiral. And let the old P.C. be at station $615+46.2$.

$$\begin{array}{rcl} R & = & 1146.28 \\ R' & = & 1042.14 \\ \hline R - R' & = & 104.14 \end{array} \qquad \begin{array}{rcl} R - R' & = & 104.14 \\ p & = & 0.67 \\ \hline R - R' - p & = & 103.47 \end{array}$$

$$\begin{array}{l} \log (R - R' - p) = 2.014814 \\ \log (R - R') = 2.017618 \\ \hline \log \cos J = 9.997196 - 10 \end{array}$$

$$J = 6^{\circ} 30'.$$

Length of five-degree curve from P.C. to P.C.C. is 130 ft.

$$I = 3^{\circ} 49.5' \qquad J - I = 2' 40.5'.$$

Length of $5^{\circ} 30'$ curve from P.S.C. to P.C.C. is 48.6 ft.

Length of spiral is 150 ft.

$$SH = 130.6 \text{ ft.}$$

$$BH = (R' + p) \tan J + d = 199.2 \text{ ft.}$$

$$BS = 68.6 \text{ ft.}$$

Along the old line the distance is $68.6 + 130 = 198.6$ ft. from *B* to *D*. And along the new line this distance is $150 + 48.6 = 198.6$. The change in length is negligible, although there is a very slight shortening.

The P.S. is at station $615 + 46.2 - 68.6 = 614 + 77.6$.

The transit notes for this revision follow as they appear when 25-ft. spiral chords are employed.

It may be mentioned that a great advantage in this style of revision lies in retaining the track as far as possible on the old roadbed which has been beaten solid by the traffic.

Stations	Align- ment.	Deflection Angles.	Back Sight Angles.	Functions.	Courses.
620	Simple	Five	Degree	Curve	
619					
618					
617					
616+76.2	P.C.C.	1° 20.25'	1° 20.25'	$J = 6^\circ 30'$ $J - I = 2^\circ 40.5'$	....
616+27.6	P.S.C.	1° 08.5'	2° 41'	$L = 48.6$	....
616+02.6	...	0° 44'	.....	$D = 5^\circ 00'$	....
615+77.6	...	0° 25'	.....	$D' = 5^\circ 30'$	....
615+52.6	...	0° 12'	.....	$BS = 68.6$	....
615+27.6	...	0° 04'	.....	.....	....
615+02.6	...	0° 00.5'	.....	$I = 3^\circ 49.5'$	....
614+77.6	P.S.	0° 00'	.....	$L = 150$	....
614	...	.....	.....	.....	....

Work of this nature is always confined to the area of the roadbed and, therefore, the transit need be set up at only the P.S. and P.S.C.

Before starting out to carry on revisions of this sort, it is best to calculate J , BS , and the length of curve to the P.C.C. along both old and new lines for all the curves to be spiraled, as this will eliminate all field figuring and the work will be greatly quickened thereby.

46. To Increase the Curvature throughout and Add Spirals without Changing the Length of the Line. This is an indeterminate problem, but it may be solved by trial.

D = degree of original curve.

D' = degree of new spiraled curve.

L = length of spiral chosen.

Length of old curve is $A/D \times 100$.

Length of new curve is $2L + (A - 2I)/D' \times 100$.

This distance, P.S. to P.T., must equal $A/D \times 100 + 2BS$

The unknown quantities are D' , I , and BS .

It is known that D' is slightly greater than D , the difference depending upon A . And I may be closely approximated from the chosen value of L and an assumed D' .

$$BS = T' - T = (R' + p) \tan \frac{1}{2}A + d - R \tan \frac{1}{2}A.$$

Example, $A = 24^\circ 00'$, $D = 5^\circ 00'$, length of old curve = 480 ft., and $T = 243.65$. To re-run inserting spirals 150 ft. in length without change in length of steel:

Assume	$D' = 5^\circ 30'$
	$I = 3^\circ 49.5'$
	$\log \tan \frac{1}{2}A = 9.327475$
	$\log (R' + p) = 3.018205$
	<hr/>
	$\log 221.66 = 2.345680$
	$d = 80.42$
	<hr/>
	$T' = 302.08$
	$T = 243.65$
	<hr/>
	$BS = 58.43$

$A - 2I = 16^\circ 21'$, and the length of simple curve = 297.27.

Total length of new curve is 597.27.

The distance from the P.S. to the P.T. by the old line is $2 \times 58.43 + 480 = 596.86$. And the new line is longer by 0.41 ft. D' must be decreased slightly. The difference is so small that the $5^\circ 30'$ spiral may be used and the work thus shortened. Or a new D' with the correct spiral may be assumed. In either case the solution is long and tedious and requires considerable figuring in the field. When the original notes are obtainable, all calculations may be made in the office before the field work is begun.

This method gives very satisfactory results, as there is neither compounding nor change in length of steel. But curves of extremely odd degree, especially when D extends into fractions of a second, are cumbrous and should be avoided as they are decidedly objectionable.

47. To Decrease the Radius and Insert Spirals with a Slight Change in Length. This problem resolves itself into a simple and easily solved form of the problem immediately

preceding. In this case D' is some ordinary quantity slightly greater than D . And the exact length of line is unimportant.

In this case the curve will be thrown inward at its ends and out at the middle. Or Q must be decreased.

Q of the unspiraled curve is

$$Q = R \operatorname{exsec} \frac{1}{2} A.$$

In the spiraled curve Q' is

$$Q' = (R' + p) \operatorname{exsec} \frac{1}{2} A + p.$$

If Q is to be reduced by the distance p , then $Q' = Q - p$.

$$\text{And } R \operatorname{exsec} \frac{1}{2} A - p = (R' + p) \operatorname{exsec} \frac{1}{2} A + p.$$

$$[R - (R' + p)] \operatorname{exsec} \frac{1}{2} A = 2p.$$

$$(R' + p) = R - 2p / \operatorname{exsec} \frac{1}{2} A. = R - \frac{2 p \cos \frac{1}{2} A}{1 - \cos \frac{1}{2} A}$$

A and R are known and $(R' + p)$ may be quickly found by trial. When it is desired to retain the track in approximately its original position at the center, then $Q' = Q$, and

$$(R' + p) \operatorname{exsec} \frac{1}{2} A + p = R \operatorname{exsec} \frac{1}{2} A.$$

$$(R' + p) = R - p / \operatorname{exsec} \frac{1}{2} A. = R - \frac{p \cos \frac{1}{2} A}{1 - \cos \frac{1}{2} A}$$

And the curve in which $(R' + p)$ is the closest convenient value may be selected.

48. The author believes that sufficient forms of revision have been explained to enable an intelligent man to direct work of this nature in a satisfactory manner. The engineer in charge of such work can alter these methods and proceed according to his own judgment in special cases where general styles of revision are not applicable.

Sufficient detailed explanation has been entered into in the preceding pages to insure, after careful study, a thorough understanding of the work by all men who are—or who possess the necessary ingenuity and judgment to become—civil engineers. And the author does not wish to burden engineers with the mass of details required in the coaching of others into the intricacies of this branch of the profession.

SUMMARY OF FORMULAS

The formulas most commonly used are grouped together here for convenience in reference. The numbers given in the text accompany the respective formulas. And the article in which the formula occurs is also given, as this will at times prove to be of further advantage in refreshing the memory regarding principles:

Number.	Formula.	Article.
17	$T = d + (R + p) \tan \frac{1}{2}A.$ This formula gives the tangent distance. $\log (R + p)$ is found in the tables.	37
18	$L = 100 \frac{A - 2I}{D}.$ L is the length of simple curve between spirals.	37
19	$Q = (R + p) / \cos \frac{1}{2}A - R.$	37
20	$Q = (R + p) \operatorname{exsec} \frac{1}{2}A + p.$ These two formulas give the shortest distance from the P.I. to the spiraled curve.	37

To obtain a spiral not tabulated multiply together the desired length of spiral and degree of curve. Divide the product by 1800. By this resulting factor multiply any desired angle in Table III. Use the nearest half minute in deflecting angles. This table is explained in Art. 35. It is reproduced on succeeding pages in three different forms to suit the tastes of various engineers.

When the spiral functions are also desired for the spiral of length L to a curve of degree D , find the product of D and L , select the two tables showing the product DL nearest the desired value, between these tables interpolate mentally for the x corresponding to any given length of spiral L' , multiply by L/L' . The result is the required x . The other functions are determined by the following formulas:

Number.	Formula.	Article.
14	$y = x$ multiplied by tangent of deflection P.S.— P.S.C.	36
15	$p = y + R \cos I - R.$	36
16	$d = x - R \sin I.$	36

As with all other angles I equals the I of Table III multiplied by $DL/1800$ ($8^{\circ} 20' 26''$, $8^{\circ} 20.4'$, 8.34° , or $500.4'$).

For use with the metric system, lay out curve by means of a twenty-meter tape instead of 100 ft. Divide all tabulated distances by FIVE, but do not alter any angles. This is the method ordinarily employed in the metric system. Obviously metric curves are sharper by approximately 50 per cent than the American curves of the same nominal degree.

TABLES

TABLE III

DEFLECTIONS FOR A 600-FOOT SPIRAL TO A THREE-DEGREE CURVE

(Angles expressed in degrees and minutes to the nearest tenth of one minute)

$$DL = 1800$$

$$I = 8^{\circ} 20.4'$$

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	0° 01.5'	0° 08.3'	0° 25.8'	0° 55.1'	1° 36.3'	2° 29.2'
1	0° 03.0'	1	0 10.7	0 33.5	1 08.5	1 55.4	2 54.3
2	0 23.6	0° 16.7'	2	0 28.9	1 10.0	2 03.0	3 07.8
3	1 10.0	0 57.8	0° 35.0'	3	0 47.1	1 46.1	2 56.9
4	2 20.9	2 03.0	1 34.1	0° 53.1'	4	1 04.9	2 21.6
5	3 55.4	3 31.8	2 56.8	2 09.8	1° 10.8'	5	1 22.5
P.S.C.	5 51.2	5 21.6	4 40.7	3 47.7	2 42.8	1° 26.2'	P.S.C.

(Angles expressed in degrees to the nearest hundredth of one degree)

$$DL = 1800$$

$$I = 8.34^{\circ}$$

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	0.03°	0.14°	0.43°	0.92°	1.61°	2.49°
1	0.05°	1	0.18	0.56	1.14	1.92	2.90
2	0.39	0.27°	2	0.48	1.17	2.05	3.13
3	1.16	0.95	0.58°	3	0.79	1.77	2.95
4	2.35	2.05	1.57	0.89°	4	1.08	2.36
5	3.92	3.53	2.95	2.17	1.18°	5	1.37
P.S.C.	5.85	5.36	4.68	3.80	2.71	1.44°	P.S.C.

(Angles expressed in minutes to the nearest tenth of one minute)

$$DL = 1800$$

$$I = 500.4'$$

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	01.5'	08.3'	25.8'	55.1'	96.3'	149.2'
1	03.0'	1	10.7	33.5	68.5	115.4	174.3
2	23.6	16.7'	2	28.9	70.0	123.0	187.8
3	70.0	57.8	35.0'	3	47.1	106.1	176.9
4	140.9	123.0	94.1	53.1'	4	64.9	141.6
5	235.4	211.8	176.8	129.8	70.8'	5	82.5
P.S.C.	351.2	321.6	280.7	227.7	162.8	86.2'	P.S.C.

TABLE IV

SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL=75$

(Using six equal chords)

 $I=0^{\circ} 21'$

FUNCTIONS

L	D	x	y	d	p	$\log(R+p)$
150	$0^{\circ} 30'$	150	0.26	80.00	0.05	4.059157
225	0 20	225	0.39	120.00	0.07	4.235247
300	0 15	300	0.52	160.00	0.09	4.360185
450	0 10	450	0.78	240.00	0.14	4.536276

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	.....	$0^{\circ} 00.3'$	$0^{\circ} 01'$	$0^{\circ} 02'$	$0^{\circ} 04'$	$0^{\circ} 06'$
1	.....	1	0 00.5	0 01.5	0 03	0 05	0 07
2	$0^{\circ} 01'$	$0^{\circ} 00.5'$	2	0 01	0 03	0 05	0 08
3	0 02.5'	0 02'	$0^{\circ} 01.5'$	3	0 02	0 04.5'	0 07.5'
4	0 06'	0 05	0 04'	$0^{\circ} 02.5'$	4	0 02.5'	0 06'
5	0 09.5'	0 08.5'	0 07.5'	0 05.5	$0^{\circ} 03'$	5	0 03.5'
P.S.C.	0 15'	0 13.5	0 11.5	0 09.5	0 06.5'	$0^{\circ} 03.5'$	P.S.C.

TABLE V

SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL=150$

(Using six equal chords)

 $I=0^{\circ} 41.5'$

FUNCTIONS

L	D	x	y	d	p	$\log(R+p)$
150	$1^{\circ} 00'$	150	0.54	80.84	0.13	3.758132
225	0 40	225	0.82	121.25	0.19	3.934226
300	0 30	300	1.09	161.68	0.26	4.059164
450	0 20	449.99	1.64	242.49	0.39	4.235256

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	.....	$0^{\circ} 00.5'$	$0^{\circ} 02'$	$0^{\circ} 04.5'$	$0^{\circ} 08'$	$0^{\circ} 12.5'$
1	.....	1	0 00.5	0 03	0 06'	0 09.5'	0 14.5
2	$0^{\circ} 02'$	$0^{\circ} 01.5'$	2	0 02.5'	0 06	0 10'	0 15.5
3	0 06	0 04.5	$0^{\circ} 03'$	3	0 04	0 09	0 15'
4	0 12	0 10'	0 08	$0^{\circ} 04.5'$	4	0 05.5'	0 12
5	0 19.5'	0 17.5'	0 15	0 10.5	$0^{\circ} 05.5'$	5	0 07'
P.S.C.	0 29'	0 26.5	0 23.5'	0 18.5	0 13'	$0^{\circ} 07'$	P.S.C.

TABLE VI

SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL=225$

(Using six equal chords)

 $I=1^{\circ} 02.5'$

FUNCTIONS

L	D	x	y	d	p	$\log(R+p)$
150	$1^{\circ} 30'$	150	0.81	80.56	0.18	3.582064
225	$1^{\circ} 00'$	225	1.21	120.84	0.26	3.758148
300	$0^{\circ} 45'$	300	1.62	161.12	0.36	3.883085
450	$0^{\circ} 30'$	449.99	2.42	241.67	0.53	4.059175

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	.....	$0^{\circ} 01'$	$0^{\circ} 03'$	$0^{\circ} 07'$	$0^{\circ} 12'$	$0^{\circ} 18.5'$
1	.....	1	0 01.5'	0 04	0 08.5'	0 14.5'	0 22'
2	$0^{\circ} 03'$	$0^{\circ} 02'$	2	0 03.5'	0 08.5	0 15.5	0 23.5'
3	0 09	0 07.5'	$0^{\circ} 04.5'$	3	0 06'	0 13.5	0 22'
4	0 17.5'	0 15.5	0 12'	$0^{\circ} 06.5'$	4	0 08'	0 17.5'
5	0 29.5	0 26.5	0 22	0 16'	$0^{\circ} 09'$	5	0 10'
P.S.C.	0 44'	0 40'	0 35	0 28.5'	0 20.5'	$0^{\circ} 11'$	P.S.C.

TABLE VII

SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL=300$

(Using six equal chords)

 $I=1^{\circ} 23.5'$

FUNCTIONS

L	D	x	y	d	p	$\log(R+p)$
150	$2^{\circ} 00'$	149.99	1.09	80.41	0.25	3.457152
225	$1^{\circ} 20'$	224.99	1.64	120.62	0.37	3.633231
300	$1^{\circ} 00'$	299.98	2.18	160.83	0.49	3.758166
450	$0^{\circ} 40'$	449.98	3.27	241.25	0.73	3.934253

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	$0^{\circ} 00.5'$	$0^{\circ} 01.5'$	$0^{\circ} 04.5'$	$0^{\circ} 09'$	$0^{\circ} 16'$	$0^{\circ} 25'$
1	$0^{\circ} 00.5'$	1	0 01.5	0 05.5	0 11.5'	0 19	0 29
2	0 04'	$0^{\circ} 03'$	2	0 05'	0 11.5	0 20.5'	0 31
3	0 11.5'	0 09.5'	$0^{\circ} 05.5'$	3	0 08'	0 17.5	0 29.5'
4	0 23.5	0 20'	0 15.5	$0^{\circ} 08.5'$	4	0 11'	0 23.5
5	0 39'	0 35	0 29'	0 21.5	$0^{\circ} 11.5'$	5	0 14'
P.S.C.	0 58.5'	0 53.5'	0 47	0 38'	0 27.5	$0^{\circ} 14.5'$	P.S.C.

TABLE VIII
SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL=375$
(Using six equal chords)

$$I=1^{\circ} 44.5'$$

FUNCTIONS

L	D	x	y	d	p	$\log(R+p)$
150	$2^{\circ} 30'$	149.99	1.35	80.33	0.29	3.360272
225	$1^{\circ} 40'$	224.98	2.03	120.49	0.44	3.536345
300	$1^{\circ} 15'$	299.97	2.70	160.65	0.57	3.661275
450	$0^{\circ} 50'$	449.96	4.06	240.99	0.88	3.837363

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	$0^{\circ} 00.5'$	$0^{\circ} 02'$	$0^{\circ} 05.5'$	$0^{\circ} 11.5'$	$0^{\circ} 20'$	$0^{\circ} 31'$
1	$0^{\circ} 00.5'$	1	$0^{\circ} 02'$	$0^{\circ} 07'$	$0^{\circ} 14.5'$	$0^{\circ} 24'$	$0^{\circ} 36.5'$
2	$0^{\circ} 05'$	$0^{\circ} 04'$	2	$0^{\circ} 06'$	$0^{\circ} 14.5'$	$0^{\circ} 25.5'$	$0^{\circ} 39'$
3	$0^{\circ} 14.5'$	$0^{\circ} 12'$	$0^{\circ} 07'$	3	$0^{\circ} 10'$	$0^{\circ} 22'$	$0^{\circ} 37'$
4	$0^{\circ} 29.5'$	$0^{\circ} 25.5'$	$0^{\circ} 19.5'$	$0^{\circ} 11'$	4	$0^{\circ} 13.5'$	$0^{\circ} 29.5'$
5	$0^{\circ} 49.5'$	$0^{\circ} 44.5'$	$0^{\circ} 37'$	$0^{\circ} 27.5'$	$0^{\circ} 15'$	5	$0^{\circ} 17'$
P.S.C.	$1^{\circ} 13.5'$	$1^{\circ} 07'$	$0^{\circ} 58.5'$	$0^{\circ} 47.5'$	$0^{\circ} 34'$	$0^{\circ} 18'$	P.S.C.

TABLE IX
SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL=450$
(Using six equal chords)

$$I=2^{\circ} 05'$$

FUNCTIONS

L	D	x	y	d	p	$\log(R+p)$
150	$3^{\circ} 00'$	149.98	1.61	80.55	0.35	3.281121
225	$2^{\circ} 00'$	224.97	2.42	120.82	0.53	3.457194
300	$1^{\circ} 30'$	299.97	3.22	161.11	0.70	3.582123
450	$1^{\circ} 00'$	449.95	4.84	241.66	1.05	3.758209

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	$0^{\circ} 00.5'$	$0^{\circ} 02'$	$0^{\circ} 06.5'$	$0^{\circ} 14'$	$0^{\circ} 24'$	$0^{\circ} 37'$
1	$0^{\circ} 00.5'$	1	$0^{\circ} 02.5'$	$0^{\circ} 08.5'$	$0^{\circ} 17'$	$0^{\circ} 29'$	$0^{\circ} 43.5'$
2	$0^{\circ} 06'$	$0^{\circ} 04.5'$	2	$0^{\circ} 07.5'$	$0^{\circ} 17.5'$	$0^{\circ} 31'$	$0^{\circ} 47'$
3	$0^{\circ} 17.5'$	$0^{\circ} 14.5'$	$0^{\circ} 08.5'$	3	$0^{\circ} 11.5'$	$0^{\circ} 26.5'$	$0^{\circ} 44'$
4	$0^{\circ} 35'$	$0^{\circ} 31'$	$0^{\circ} 23.5'$	$0^{\circ} 13.5'$	4	$0^{\circ} 16.5'$	$0^{\circ} 35.5'$
5	$0^{\circ} 59'$	$0^{\circ} 53'$	$0^{\circ} 44'$	$0^{\circ} 32.5'$	$0^{\circ} 17.5'$	5	$0^{\circ} 20.5'$
P.S.C.	$1^{\circ} 28'$	$1^{\circ} 20.5'$	$1^{\circ} 10'$	$0^{\circ} 57'$	$0^{\circ} 40.5'$	$0^{\circ} 21.5'$	P.S.C.

TABLE X

SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL=525$

(Using six equal chords)

 $I=2^{\circ} 26'$

FUNCTIONS

L	D	x	y	d	p	$\log (R+p)$
150	3° 30'	149.98	1.90	80.46	0.43	3.214237
225	2 20	224.96	2.85	120.70	0.64	3.390288
300	1 45	299.95	3.79	160.94	0.85	3.515214
450	1 10	449.93	5.69	241.42	1.26	3.691295

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	0° 00.5'	0° 02.5'	0° 07.5'	0° 16'	0° 28'	0° 43.5'
1	0° 01'	1	0 03'	0 09.5	0 20	0 33.5'	0 51'
2	0 06.5'	0° 04.5'	2	0 08.5	0 20.5'	0 36'	0 55
3	0 20.5	0 17'	0° 10.5'	3	0 13.5	0 31	0 51.5'
4	0 41'	0 35.5'	0 27.5	0° 15.5'	4	0 19	0 41.5
5	1 09	1 02'	0 52'	0 38'	0° 21'	5	0 24'
P.S.C.	1 42.5'	1 33.5'	1 22	1 06.5'	0 47.5'	0° 25'	P.S.C.

TABLE XI

SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL=600$

(Using six equal chords)

 $I=2^{\circ} 47'$

FUNCTIONS

L	D	x	y	d	p	$\log (R+p)$
150	4° 00'	149.97	2.18	80.40	0.49	3.156301
225	2 40	224.95	3.27	120.61	0.73	3.332341
300	2 00	299.94	4.36	160.82	0.98	3.457262
450	1 20	449.91	6.54	241.24	1.47	3.633342

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	0° 00.5'	0° 03'	0° 08.5'	0° 18.5'	0° 32'	0° 50'
1	0° 01'	1	0 03.5'	0 11'	0 23'	0 38.5'	0 58
2	0 08	0° 06'	2	0 09.5'	0 23.5'	0 41'	1 02.5'
3	0 23.5'	0 19.5'	0° 11.5'	3	0 16'	0 35.5'	0 59'
4	0 47.5	0 41.5	0 31.5	0° 18'	4	0 21.5'	0 47
5	1 18.5	1 10.5	0 58.5	0 43	0° 23'	5	0 27.5'
P.S.C.	1 57'	1 47.5	1 33.5	1 16	0 54	0° 29'	P.S.C.

TABLE XII
SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL=675$
(Using six equal chords)

$I=3^{\circ} 08'$

FUNCTIONS

L	D	x	y	d	p	$\log(R+p)$
150	$4^{\circ} 30'$	149.96	2.44	80.35	0.54	3.105207
225	3 00	224.94	3.66	120.54	0.80	3.281234
300	2 15	299.92	4.88	160.72	1.07	3.406150
450	1 30	449.88	7.33	241.09	1.62	3.582228

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	$0^{\circ} 00.5'$	$0^{\circ} 03'$	$0^{\circ} 10'$	$0^{\circ} 20.5'$	$0^{\circ} 36'$	$0^{\circ} 56'$
1	$0^{\circ} 01'$	1	0 04	0 12.5'	0 26'	0 43	1 05.5'
2	0 09	$0^{\circ} 06.5'$	2	0 11'	0 26	0 46	1 10.5
3	0 26	0 22'	$0^{\circ} 13'$	3	0 17.5'	0 40	1 06.5
4	0 53	0 46	0 35.5'	$0^{\circ} 20'$	4	0 24.5'	0 53'
5	1 28	1 19.5'	1 06'	0 48	$0^{\circ} 26'$	5	0 31
P.S.C.	2 12	2 01'	1 45.5'	1 25.5'	1 01.5'	$0^{\circ} 33'$	P.S.C.

TABLE XIII
SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL=750$
(Using six equal chords)

$I=3^{\circ} 28.5'$

FUNCTIONS

L	D	x	y	d	p	$\log(R+p)$
150	$5^{\circ} 00'$	149.95	2.70	80.47	0.59	3.059514
225	3 20	224.93	4.06	120.73	0.90	3.235533
300	2 30	299.90	5.40	160.97	1.18	3.360440
450	1 40	449.86	8.11	241.48	1.79	3.536515

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	$0^{\circ} 00.5'$	$0^{\circ} 03.5'$	$0^{\circ} 11'$	$0^{\circ} 23'$	$0^{\circ} 40'$	$1^{\circ} 02'$
1	$0^{\circ} 01.5'$	1	0 04.5	0 14	0 28.5'	0 48	1 12.5'
2	0 10'	$0^{\circ} 07'$	2	0 12	0 29'	0 51	1 18'
3	0 29	0 24	$0^{\circ} 14.5'$	3	0 19.5'	0 44	1 13.5'
4	0 59	0 51.5'	0 39.5	$0^{\circ} 22.5'$	4	0 27	0 59'
5	1 38	1 28'	1 13.5	0 54'	$0^{\circ} 29'$	5	0 34.5'
P.S.C.	2 26.5'	2 14	1 57'	1 35	1 07.5'	$0^{\circ} 36'$	P.S.C.

TABLE XIV

SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL=825$

(Using six equal chords)

 $I=3^{\circ} 49.5'$

FUNCTIONS

L	D	x	y	d	p	$\log(R+p)$
150	$5^{\circ} 30'$	149.94	2.99	80.42	0.67	3.018205
225	3 40	224.91	4.48	120.65	1.00	3.194204
300	2 45	299.88	5.98	160.88	1.34	3.319110
450	1 50	449.82	8.96	241.33	2.00	3.495178

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	$0^{\circ} 00.5'$	$0^{\circ} 04'$	$0^{\circ} 12'$	$0^{\circ} 25'$	$0^{\circ} 44'$	$1^{\circ} 08.5'$
1	$0^{\circ} 01.5'$	1	0 05	0 15.5'	0 31.5'	0 53	1 20'
2	0 11'	$0^{\circ} 08'$	2	0 13'	0 32'	0 56.5'	1 26
3	0 32	0 26.5'	$0^{\circ} 16'$	3	0 21.5'	0 48.5	1 21
4	1 04.5'	0 56'	0 42.5'	$0^{\circ} 24'$	4	0 30'	1 05
5	1 48'	1 37	1 20.5	0 59.5'	$0^{\circ} 32.5'$	5	0 38
P.S.C.	2 41	2 27.5'	2 08.5	1 44.5	1 15'	$0^{\circ} 39.5'$	P.S.C.

TABLE XV

SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL=900$

(Using six equal chords)

 $I=4^{\circ} 10'$

FUNCTIONS

L	D	x	y	d	p	$\log(R+p)$
150	$6^{\circ} 00'$	149.93	3.25	80.51	0.72	2.980499
225	4 00	224.90	4.87	120.80	1.08	3.156479
300	3 00	299.86	6.50	161.08	1.45	3.281381
450	2 00	449.79	9.75	241.63	2.18	3.457445

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	$0^{\circ} 00.5'$	$0^{\circ} 04'$	$0^{\circ} 13'$	$0^{\circ} 27.5'$	$0^{\circ} 48'$	$1^{\circ} 14.5'$
1	$0^{\circ} 01.5'$	1	0 05.5'	0 17	0 34'	0 58	1 27'
2	0 12'	$0^{\circ} 08.5'$	2	0 14.5'	0 35	1 01.5'	1 34
3	0 35	0 29'	$0^{\circ} 17.5'$	3	0 23.5'	0 53'	1 28.5'
4	1 10.5'	1 02	0 47'	$0^{\circ} 26.5'$	4	0 32.5'	1 11'
5	1 58'	1 46	1 28.5'	1 05'	$0^{\circ} 35.5'$	5	0 41
P.S.C.	2 55.5'	2 41	2 20'	1 53.5'	1 21'	$0^{\circ} 43'$	P.S.C.

TABLE XVI

SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL=1050$

(Using six equal chords)

$$I=4^{\circ} 52'$$

FUNCTIONS

L	D			d	p	$\log(R+p)$
150	7° 00'	149.90	3.80	80.42	0.85	2.913745
225	4 40	224.86	5.69	120.67	1.26	3.089683
300	3 30	299.81	7.60	160.91	1.71	3.214576
450	2 20	449.72	11.38	241.38	2.53	3.390623

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	0° 01'	0° 05'	0° 15'	0° 32'	0° 56'	1° 27'
1	0° 02'	1	0 06	0 19.5'	0 40	1 07.5'	1 41.5'
2	0 14	0° 10'	2	0 17'	0 41	1 12'	1 49.5
3	0 41	0 33.5'	0° 20'	3	0 27.5'	1 02	1 43'
4	1 22.5'	1 11.5	0 54.5'	0° 31'	4	0 38	1 22.5'
5	2 17.5	2 03'	1 42.5	1 15.5'	0° 41'	5	0 48'
P.S.C.	3 25'	3 07.5'	2 43.5	2 13'	1 35	0° 50.5'	P.S.C.

TABLE XVII

SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL=1200$

(Using six equal chords)

$$I=5^{\circ} 33.5'$$

FUNCTIONS

L	D	x	y	d	p	$\log(R+p)$
150	8° 00'	149.87	4.34	80.44	0.97	2.855973
225	5 20	224.81	6.51	120.72	1.46	3.031869
300	4 00	299.75	8.68	160.98	1.94	3.156740
450	2 40	449.63	13.02	241.50	2.92	3.332783

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	0° 01'	0° 05.5'	0° 17'	0° 37'	1° 04'	1° 39.5'
1	0° 02'	1	0 07'	0 22.5'	0 45.5'	1 17	1 56'
2	0 16	0° 11.5'	2	0 19'	0 46.5	1 22	2 05
3	0 46.5'	0 38'	0° 23'	3	0 31.5	1 11	1 58
4	1 34'	1 22.5'	1 03	0° 36'	4	0 43.5'	1 34.5'
5	2 37	2 21'	1 57.5'	1 26.5'	0° 46.5'	5	0 55'
P.S.C.	3 54	3 34.5'	3 07'	2 32'	1 48'	0° 57.5'	P.S.C.

TABLE XVIII
SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL=1350$
(Using six equal chords)

$$I=6^{\circ} 15.5'$$

FUNCTIONS

L	D	x	y	d	p	$\log(R+p)$
150	9° 00'	149.84	4.88	80.37	1.08	2.805062
225	6 00	224.76	7.33	120.61	1.64	2.980913
300	4 30'	299.69	9.76	160.86	2.17	3.105762
450	3 00	449.53	14.65	241.31	3.27	3.281794

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	0° 01'	0° 06'	0° 19.5'	0° 41.5'	1° 12'	1° 52'
1	0° 02'	1	0 08'	0 25'	0 51.5	1 26.5'	2 10.5'
2	0 18	0° 13'	2	0 22	0 52.5	1 32'	2 21'
3	0 52.5'	0 44	0° 26'	3	0 35'	1 19.5'	2 12.5'
4	1 45.5	1 32.5'	1 10.5'	0° 40'	4	0 49'	1 46'
5	2 57'	2 39.5	2 13'	1 37.5'	0° 53'	5	1 02
P.S.C.	4 23.5'	4 02'	3 30.5'	2 51'	2 02.5'	1° 04.5'	P.S.C.

TABLE XIX
SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL=1500$
(Using six equal chords)

$$I=6^{\circ} 57'$$

FUNCTIONS

L	D	x	y	d	p	$\log(R+p)$
150	10° 00'	149.80	5.43	80.38	1.22	2.759592
225	6 40	224.71	8.14	120.61	1.82	2.935376
300	5 00	299.61	10.86	160.91	2.44	3.060214
450	3 20	449.42	16.28	241.30	3.65	3.236227

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	0° 01.5'	0° 07'	0° 21.5'	0° 46'	1° 20'	2° 04.5'
1	0° 02.5'	1	0 09	0 28'	0 57	1 36	2 25'
2	0 19.5	0° 13.5'	2	0 24	0 58	1 42.5'	2 36.5'
3	0 58'	0 47.5	0° 29'	3	0 39	1 28.5	2 27.5
4	1 57.5'	1 42.5	1 19	0° 45'	4	0 54'	1 58'
5	3 16'	2 56'	2 27	1 48	0° 58.5'	5	1 09
P.S.C.	4 52.5'	4 28	3 54	3 10	2 15.5	1° 12'	P.S.C.

TABLE XX

SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL = 1650$

(Using six equal chords)

 $I = 7^\circ 39'$

FUNCTIONS

L	D	x	y	d	p	$\log(R+p)$
150	$11^\circ 00'$	149.76	5.97	80.32	1.33	2.718502
225	7 20	224.65	8.96	120.57	2.00	2.894227
300	5 30	299.53	11.94	160.80	2.66	3.019033
450	3 40	449.30	17.92	241.25	4.01	3.195039

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	$0^\circ 01.5'$	$0^\circ 07.5'$	$0^\circ 24'$	$0^\circ 50.5'$	$1^\circ 28'$	$2^\circ 17'$
1	$0^\circ 02.5'$	1	0 09.5	0 30.5	1 02.5	1 46	2 40
2	0 21.5	$0^\circ 15.5'$	2	0 26.5	1 04'	1 53	2 52
3	1 04'	0 53.5	$0^\circ 32.5'$	3	0 43	1 37	2 42
4	2 09	1 53'	1 26.5	$0^\circ 48.5'$	4	0 59.5	2 10
5	3 36	3 14	2 42'	1 59'	$1^\circ 05'$	5	1 15.5
P.S.C.	5 22	4 55	4 18	3 29	2 29.5	$1^\circ 19.5'$	P.S.C. '

TABLE XXI

SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL = 1800$

(Using six equal chords)

 $I = 8^\circ 20.5'$

FUNCTIONS

L	D	x	y	d	p	$\log(R+p)$
150	$12^\circ 00'$	149.72	6.51	80.32	1.45	2.681051
225	8 00	224.58	9.77	120.59	2.19	2.856711
300	6 00	299.44	13.03	160.80	2.92	2.981497
450	4 00	449.16	19.54	241.31	4.38	3.157478

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	$0^\circ 01.5'$	$0^\circ 08.5'$	$0^\circ 26'$	$0^\circ 55'$	$1^\circ 36'$	$2^\circ 29.5'$
1	$0^\circ 03'$	1	0 10.5	0 33.5	1 08.5	1 55.5	2 54'
2	0 23.5	$0^\circ 17'$	2	0 29'	1 10'	2 03'	3 08
3	1 10'	0 58	$0^\circ 35'$	3	0 47	1 46	2 57
4	2 21	2 03	1 34	$0^\circ 53'$	4	1 05	2 21.5'
5	3 55.5	3 31.5	2 56.5	2 09.5	$1^\circ 10.5'$	5	1 22.5
P.S.C.	5 51'	5 22'	4 40.5	3 47.5	2 43'	$1^\circ 26.5'$	P.S.C.

TABLE XXII

SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL=2100$

(Using six equal chords)

 $I=9^{\circ} 44'$

FUNCTIONS

L	D	x	y	d	p	$\log(R+p)$
150	$14^{\circ} 00'$	149.62	7.58	80.26	1.67	2.614892
225	9 20	224.43	11.37	120.53	2.52	2.790342
300	7 00	299.24	15.16	160.77	3.37	2.915067
450	4 40	448.86	22.74	241.23	5.06	3.091023

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	$0^{\circ} 01.5'$	$0^{\circ} 09.5'$	$0^{\circ} 30'$	$1^{\circ} 04'$	$1^{\circ} 52'$	$2^{\circ} 54'$
1	$0^{\circ} 03.5'$	1	0 12.5	0 39	1 20	2 15	3 23.5'
2	0 27.5	$0^{\circ} 19.5'$	2	0 34	1 21.5'	2 23.5'	3 39'
3	1 21.5	1 07.5	$0^{\circ} 40.5'$	3	0 55'	2 04'	3 26.5'
4	2 44.5	2 23.5	1 50'	$1^{\circ} 02'$	4	1 16	2 45'
5	4 35'	4 07'	3 26.5'	2 31.5'	$1^{\circ} 22.5'$	5	1 36
P.S.C.	6 50	6 15.5'	5 28'	4 26'	3 10.5	$1^{\circ} 41'$	P.S.C.

TABLE XXIII

SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL=2400$

(Using six equal chords)

 $I=11^{\circ} 07'$

FUNCTIONS

L	D	x	y	d	p	$\log(R+p)$
150	$16^{\circ} 00'$	149.50	8.66	80.23	1.92	2.557735
225	10 40	224.26	13.00	120.54	2.91	2.733061
300	8 00	299.00	17.32	160.80	3.87	2.857724
450	5 20	448.51	25.99	241.30	5.83	3.033629

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	$0^{\circ} 02'$	$0^{\circ} 11'$	$0^{\circ} 34.5'$	$1^{\circ} 13.5'$	$2^{\circ} 08'$	$3^{\circ} 19'$
1	$0^{\circ} 04'$	1	0 14	0 45'	1 31'	2 34	3 52
2	0 31.5'	$0^{\circ} 22.5'$	2	0 38.5'	1 33	2 44	4 10.5'
3	1 33.5	1 17'	$0^{\circ} 47'$	3	1 03	2 21.5'	3 56'
4	3 08'	2 44.5'	2 06	$1^{\circ} 10.5'$	4	1 26.5	3 09
5	5 14	4 42'	3 55.5'	2 52.5	$1^{\circ} 34'$	5	1 50'
P.S.C.	7 48	7 09	6 14'	5 03'	3 36.5'	$1^{\circ} 55'$	P.S.C.

TABLE XXIV
SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL=2700$
(Using six equal chords)

$$I=12^{\circ} 31'$$

FUNCTIONS

L	D	x	y	d	p	$\log(R+p)$
150	18° 00'	149.37	9.75	80.10	2.15	2.50754
225	12 00	224.06	14.62	120.39	3.25	2.6826767
300	9 00	298.75	19.49	160.64	4.34	2.827274
450	6 00	448.12	29.24	241.07	6.53	2.983130

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	0° 02.5'	0° 12.5'	0° 39'	1° 22.5'	2° 24.5'	3° 44'
1	0° 04.5'	1	0 16'	0 50	1 43'	2 53'	4 21.5'
2	0 35.5	0° 25'	2	0 43	1 45	3 04.5'	4 42'
3	1 45'	1 27	0° 53'	3	1 10.5'	2 39'	4 25
4	3 31.5'	3 04	2 21	1° 19.5'	4	1 37.5'	3 32.5'
5	5 53'	5 17.5'	4 25	3 14.5	1° 46'	5	2 04'
P.S.C.	8 47	8 02.5	7 01	5 42'	4 04.5'	2° 09.5'	P.S.C.

TABLE XXV
SPIRAL DEFLECTIONS AND FUNCTIONS WHEN $DL=3000$
(Using six equal chords)

$$I=13^{\circ} 54'$$

FUNCTIONS

L	D	x	y	d	p	$\log(R+p)$
150	20° 00'	149.21	10.83	80.04	2.40	2.462907
225	13 20	223.84	16.24	120.38	3.63	2.637810
300	10 00	298.43	21.65	160.61	4.85	2.762333
450	6 40	447.68	32.48	241.10	7.30	2.938129

DEFLECTIONS

	P.S.	1	2	3	4	5	P.S.C.
P.S.	P.S.	0° 02.5'	0° 14'	0° 43'	1° 32'	2° 40.5'	4° 09'
1	0° 05'	1	0 18	0 56	1 54	3 12.5	4 50.5'
2	0 39.5'	0° 28'	2	0 48	1 56.5'	3 25'	5 13'
3	1 56.5	1 36	0° 58'	3	1 18.5	2 57	4 55
4	3 55'	3 25.5'	2 37	1° 39'	4	1 48	3 56
5	6 32	5 52.5	4 54	3 36	1° 57.5'	5	2 17.5'
P.S.C.	9 45	8 56'	7 47.5'	6 19.5'	4 31'	2° 24'	P.S.C.

TABLE XXVI.—RADII AND LOGARITHMS.

Deg. D.	Radius. R.	Loga- rithm. log R.	Deg. D.	Radius. R.	Loga- rithm. log R.	Deg. D.	Radius. R.	Loga- rithm. log R.
0°	Infinite	Infinite	0°			1°		
1'	343775	5.536274	51'	6740.74	3.828708	41'	3403.83	3.531968
2	171887	.235244	52	6611.12	.820275	42	3370.46	.527690
3	114592	.059153	53	6486.38	.812002	43	3337.74	.523453
4	85943.7	4.934214	54	6366.26	.803885	44	3305.65	.519257
			55	6250.51	.795916	45	3274.17	.515101
5	68754.9	4.837304	56	6138.90	3.788091	46	3243.29	3.510985
6	57295.8	.758123	57	6031.20	.780404	47	3212.98	.506908
7	49110.7	.691176	58	5927.22	.772851	48	3183.23	.502868
8	42971.8	.633184	59	5826.76	.765427	49	3154.03	.498866
9	38197.2	.582031	60	5729.65	.758128	50	3125.36	.494900
10	34377.5	4.536274	1°	5729.65	3.758128	51	3097.20	3.490970
11	31252.3	.494881	1'	5635.72	.750950	52	3069.55	.487075
12	28647.8	.457093	2	5544.83	.743888	53	3042.39	.483215
13	26444.2	.422331	3	5456.82	.736939	54	3015.71	.479389
14	24555.4	.390146	4	5371.56	.730100	55	2989.48	.475596
15	22918.3	4.360183	5	5288.92	3.723367	56	2963.71	3.471836
16	21485.9	.332154	6	5208.79	.716737	57	2938.39	.468109
17	20222.1	.305825	7	5131.05	.710206	58	2913.49	.464413
18	19098.6	.281002	8	5055.59	.703772	59	2889.01	.460749
19	18093.4	.257521	9	4982.33	.697432	60	2864.93	.457115
20	17188.8	.235244	10	4911.15	.691183	2°	2864.93	3.457115
21	16370.2	4.214055	11	4841.98	3.685023	1	2841.26	.453511
22	15626.1	.193852	12	4774.74	.678949	2	2817.97	.449937
23	14946.7	.174547	13	4709.33	.672959	3	2795.06	.446392
24	14323.6	.156064	14	4645.69	.667051	4	2772.53	.442876
25	13751.0	.138335	15	4583.75	.661221	5	2750.35	.439388
26	13222.1	4.121302	16	4523.44	3.655469	6	2728.52	3.435928
27	12732.4	.104911	17	4464.70	.649792	7	2707.04	.432495
28	12277.7	.089117	18	4407.46	.644189	8	2685.89	.429089
29	11854.3	.073877	19	4351.67	.638656	9	2665.08	.425710
30	11459.2	.059154	20	4297.28	.633194	10	2644.58	.422356
31	11089.6	4.044914	21	4244.23	3.627799	11	2624.39	3.419029
32	10743.0	.031125	22	4192.47	.622470	12	2604.51	.415727
33	10417.5	.017762	23	4141.96	.617206	13	2584.93	.412449
34	10111.1	.004797	24	4092.66	.612005	14	2565.65	.409197
35	9822.18	3.992208	25	4044.51	.606866	15	2546.64	.405968
36	9549.34	3.979973	26	3997.49	3.601787	16	2527.92	3.402763
37	9291.29	.968074	27	3951.54	.596766	17	2509.47	.399582
38	9046.75	.956493	28	3906.54	.591803	18	2491.29	.396424
39	8814.78	.945212	29	3862.74	.586896	19	2473.37	.393289
40	8594.42	.934216	30	3819.83	.582044	20	2455.70	.390176
41	8384.80	3.923493	31	3777.85	3.577245	21	2438.29	3.387085
42	8185.16	.913027	32	3736.79	.572499	22	2421.12	.384016
43	7994.81	.902808	33	3696.61	.567804	23	2404.19	.380969
44	7813.11	.892824	34	3657.29	.563160	24	2387.50	.377943
45	7639.49	.883065	35	3618.80	.558564	25	2371.04	.374938
46	7473.42	3.873519	36	3581.10	3.554017	26	2354.80	3.371954
47	7314.41	.864179	37	3544.19	.549517	27	2338.78	.368990
48	7162.03	.855036	38	3508.02	.545063	28	2322.98	.366046
49	7015.87	.846082	39	3472.59	.540654	29	2307.39	.363122
50	6875.55	.837308	40	3437.87	.536289	30	2292.01	.360217

TABLE XXVI.—RADII AND LOGARITHMS.

Deg. D.	Radius. R.	Loga- rithm. log R.	Deg. D.	Radius. R.	Loga- rithm. log R.	Deg. D.	Radius. R.	Loga- rithm. log R.
2°			3°			4°		
31'	2276.84	3.357332	21'	1710.56	3.233140	11'	1369.92	3.136697
32	2261.86	.354466	22	1702.10	.230985	12	1364.49	.134971
33	2247.08	.351618	23	1693.72	.228841	13	1359.10	.133251
34	2232.49	.348789	24	1685.42	.226707	14	1353.75	.131539
35	2218.09	.345979	25	1677.20	.224584	15	1348.45	.129833
36	2203.87	3.343187	26	1669.06	3.222472	16	1343.15	3.128134
37	2189.84	.340412	27	1661.00	.220369	17	1337.65	.126442
38	2175.98	.337655	28	1653.01	.218277	18	1332.77	.124756
39	2162.30	.334916	29	1645.11	.216195	19	1327.63	.123077
40	2148.79	.332193	30	1637.28	.214122	20	1322.53	.121404
41	2135.44	3.329488	31	1629.52	3.212060	21	1317.46	3.119738
42	2122.26	.326799	32	1621.84	.210007	22	1312.43	.118078
43	2109.24	.324127	33	1614.22	.207964	23	1307.45	.116424
44	2096.39	.321471	34	1606.68	.205930	24	1302.50	.114777
45	2083.68	.318832	35	1599.21	.203906	25	1297.58	.113136
46	2071.13	3.316208	36	1591.81	3.201892	26	1292.71	3.111501
47	2058.73	.313600	37	1584.48	.199886	27	1287.87	.109872
48	2046.48	.311008	38	1577.21	.197890	28	1283.07	.108249
49	2034.37	.308431	39	1570.01	.195903	29	1278.30	.106632
50	2022.41	.305869	40	1562.88	.193925	30	1273.57	.105022
51	2010.59	3.303323	41	1555.81	3.191956	31	1268.87	3.103417
52	1998.90	.300791	42	1548.80	.189996	32	1264.21	.101818
53	1987.35	.298274	43	1541.86	.188045	33	1259.58	.100225
54	1975.93	.295771	44	1534.98	.186103	34	1254.98	.098638
55	1964.64	.293283	45	1528.16	.184169	35	1250.42	.097057
56	1953.48	3.290809	46	1521.40	3.182244	36	1245.89	3.095481
57	1942.44	.288349	47	1514.70	.180327	37	1241.40	.093912
58	1931.53	.285902	48	1508.06	.178419	38	1236.94	.092347
59	1920.75	.283470	49	1501.48	.176519	39	1232.51	.090789
60	1910.08	.281051	50	1494.95	.174627	40	1228.11	.089236
3°	1910.08	3.281051	51	1488.48	3.172744	41	1223.74	3.087689
1	1899.53	.278646	52	1482.07	.170868	42	1219.40	.086147
2	1889.09	.276253	53	1475.71	.169001	43	1215.30	.084610
3	1878.77	.273874	54	1469.41	.167142	44	1210.82	.083079
4	1868.56	.271508	55	1463.16	.165291	45	1206.57	.081553
5	1858.47	3.269155	56	1456.96	3.163447	46	1202.36	3.080033
6	1848.48	.266814	57	1450.81	.161612	47	1198.17	.078518
7	1838.59	.264486	58	1444.72	.159784	48	1194.01	.077008
8	1828.82	.262170	59	1438.68	.157963	49	1189.88	.075504
9	1819.14	.259867	60	1432.69	.156151	50	1185.78	.074005
10	1809.57	.257576	4°	1432.69	3.156151	51	1181.71	3.072511
11	1800.10	3.255296	1'	1426.74	.154346	52	1177.66	.071022
12	1790.73	.253029	2	1420.85	.152548	53	1173.65	.069538
13	1781.45	.250774	3	1415.01	.150758	54	1169.66	.068059
14	1772.27	.248530	4	1409.21	.148975	55	1165.70	.066585
15	1763.18	.246297	5	1403.46	3.147200	56	1161.76	3.065116
16	1754.19	3.244077	6	1397.76	.145431	57	1157.85	.063653
17	1745.26	.241867	7	1392.10	.143670	58	1153.97	.062194
18	1736.48	.239669	8	1386.49	.141916	59	1150.11	.060740
19	1727.75	.237481	9	1380.92	.140170	60	1146.28	.059290
20	1719.12	.235305	10	1375.40	.138430			

TABLE XXVI.—RADII AND LOGARITHMS.

Deg. D.	Radius. R.	Loga- rithm. log R.	Deg. D.	Radius. R.	Loga- rithm. log R.	Deg. D.	Radius. R.	Loga- rithm. log R.
5°	1146.28	3.059290	51'	979.840	2.991155	6°	857.780	2.933376
1'	1142.47	.057846	52	977.060	.989921	42	855.648	.932295
2	1138.69	.056407	53	974.294	.988690	43	853.527	.931218
3	1134.94	.054972	54	971.544	.987463	44	851.417	.930142
4	1131.21	.053542	55	968.810	.986238	45	849.317	.929070
5	1127.50	3.052116	56	966.091	2.985018	46	847.228	2.928000
6	1123.82	.050696	57	963.387	.983801	47	845.148	.926933
7	1120.16	.049280	58	960.698	.982587	48	843.080	.925869
8	1116.52	.047868	59	958.025	.981377	49	841.021	.924807
9	1112.91	.046462	60	955.366	.980170	50	838.972	.923747
10	1109.33	.045059	6°	955.366	2.980170	51	836.933	2.922691
11	1105.76	3.043662	1'	952.722	.978966	52	834.904	.921637
12	1102.22	.042268	2	950.093	.977766	53	832.885	.920585
13	1098.70	.040880	3	947.478	.976569	54	830.876	.919536
14	1095.20	.039495	4	944.877	.975375	55	828.876	.918489
15	1091.73	.038115	5	942.291	2.974185	56	826.886	2.917446
16	1088.28	3.036740	6	939.719	.972998	57	824.905	.916404
17	1084.85	.035368	7	937.161	.971814	58	822.934	.915365
18	1081.44	.034002	8	934.616	.970633	59	820.973	.914329
19	1078.05	.032639	9	932.086	.969456	60	819.020	.913295
20	1074.68	.031281	10	929.569	.968282	7°	819.020	2.913295
21	1071.34	3.029927	11	927.066	2.967111	1'	817.077	.912263
22	1068.01	.028577	12	924.576	.965943	2	815.144	.911234
23	1064.71	.027231	13	922.100	.964778	3	813.238	.910208
24	1061.43	.025890	14	919.637	.963616	4	811.303	.909183
25	1058.16	.024552	15	917.187	.962458	5	809.397	2.908162
26	1054.92	3.023219	16	914.750	2.961303	6	807.499	.907142
27	1051.70	.021890	17	912.326	.960150	7	805.611	.906125
28	1048.48	.020565	18	909.915	.959001	8	803.731	.905111
29	1045.31	.019244	19	907.517	.957855	9	801.860	.904098
30	1042.14	.017927	20	905.131	.956711	10	799.997	.903089
31	1039.00	3.016614	21	902.758	2.955571	11	798.144	2.902081
32	1035.87	.015305	22	900.397	.954434	12	796.299	.901076
33	1032.76	.013999	23	898.048	.953300	13	794.462	.900073
34	1029.67	.012698	24	895.712	.952168	14	792.634	.899073
35	1026.60	.011401	25	893.388	.951040	15	790.814	.898074
36	1023.55	3.010107	26	891.076	2.949915	16	789.003	2.897078
37	1020.51	.008818	27	888.776	.948792	17	787.210	.896085
38	1017.49	.007532	28	886.488	.947673	18	785.405	.895094
39	1014.50	.006250	29	884.211	.946556	19	783.618	.894105
40	1011.51	.004972	30	881.946	.945442	20	781.840	.893118
41	1008.55	3.003698	31	879.693	2.944331	21	780.069	2.892133
42	1005.60	.002427	32	877.451	.943223	22	778.307	.891151
43	1002.67	.001160	33	875.221	.942118	23	776.552	.890171
44	999.762	2.999897	34	873.002	.941015	24	774.806	.889193
45	996.867	.998637	35	870.795	.939916	25	773.067	.888217
46	993.988	2.997381	36	868.598	2.938819	26	771.336	2.887244
47	991.126	.996129	37	866.412	.937725	27	769.613	.886272
48	988.280	.994880	38	864.238	.936633	28	767.897	.885303
49	985.451	.993635	39	862.075	.935545	29	766.190	.884336
50	982.638	.992393	40	859.922	.934459	30	764.489	.883371

TABLE XXVI.—RADII AND LOGARITHMS.

Deg. D.	Radius. R.	Loga- rithm. log R.	Deg. D.	Radius. R.	Loga- rithm. log R.	Deg. D.	Radius. R.	Loga- rithm. log R.
7°			8°			9°		
31'	762.797	2.882409	21'	686.785	2.836821	11'	624.579	2.795587
32	761.112	.881448	22	685.419	.835956	12	623.450	.794801
33	759.434	.880490	23	684.059	.835093	13	622.325	.794017
34	757.764	.879534	24	682.704	.834232	14	621.203	.793234
35	756.101	.878580	25	681.354	.833373	15	620.087	.792453
36	754.445	2.877627	26	680.010	2.832515	16	618.974	2.791673
37	752.796	.876678	27	678.671	.831660	17	617.865	.790894
38	751.155	.875730	28	677.338	.830805	18	616.760	.790117
39	749.521	.874784	29	676.008	.829953	19	615.660	.789341
40	747.894	.873840	30	674.686	.829102	20	614.563	.788566
41	746.274	2.872898	31	673.369	2.828253	21	613.470	2.787793
42	744.661	.871959	32	672.056	.827405	22	612.380	.787021
43	743.055	.871021	33	670.748	.826560	23	611.295	.786251
44	741.456	.870086	34	669.446	.825715	24	610.214	.785482
45	739.864	.869152	35	668.148	.824873	25	609.136	.784714
46	738.279	2.868221	36	666.856	2.824032	26	608.062	2.783948
47	736.701	.867291	37	665.568	.823193	27	606.992	.783183
48	735.129	.866363	38	664.286	.822355	28	605.926	.782420
49	733.564	.865438	39	663.008	.821519	29	604.864	.781657
50	732.005	.864514	40	661.736	.820685	30	603.805	.780897
51	730.454	2.863593	41	660.468	2.819852	31	602.750	2.780137
52	728.909	.862673	42	659.205	.819021	32	601.698	.779379
53	727.370	.861755	43	657.947	.818191	33	600.651	.778622
54	725.838	.860840	44	656.694	.817363	34	599.607	.777867
55	724.312	.859926	45	655.446	.816537	35	598.567	.777112
56	722.793	2.859014	46	654.202	2.815712	36	597.530	2.776360
57	721.280	.858104	47	652.963	.814889	37	596.497	.775608
58	719.774	.857196	48	651.729	.814067	38	595.467	.774858
59	718.273	.856290	49	650.499	.813247	39	594.441	.774109
60	716.779	.855385	50	649.274	.812428	40	593.419	.773361
8°	716.779	2.855385	51	648.054	2.811611	41	592.400	2.772615
1'	715.291	.854483	52	646.838	.810796	42	591.384	.771870
2	713.810	.853583	53	645.627	.809982	43	590.372	.771126
3	712.335	.852684	54	644.420	.809169	44	589.364	.770383
4	710.865	.851787	55	643.218	.808358	45	588.359	.769642
5	709.402	2.850892	56	642.021	2.807549	46	587.357	2.768902
6	707.945	.849999	57	640.828	.806741	47	586.359	.768164
7	706.493	.849108	58	639.639	.805935	48	585.364	.767426
8	705.048	.848219	59	638.455	.805130	49	584.373	.766690
9	703.609	.847331	60	637.275	.804327	50	583.385	.765955
10	702.175	.846445	9°	637.275	2.804327	51	582.400	2.765221
11	700.748	2.845562	1'	636.099	.803525	52	581.419	.764489
12	699.326	.844679	2	634.928	.802724	53	580.441	.763758
13	697.910	.843799	3	633.761	.801926	54	579.466	.763028
14	696.499	.842921	4	632.599	.801128	55	578.494	.762299
15	695.095	.842044	5	631.440	2.800332	56	577.526	2.761572
16	693.696	2.841169	6	630.286	.799538	57	576.561	.760845
17	692.302	.840296	7	629.136	.798745	58	575.599	.760120
18	690.914	.839424	8	627.991	.797953	59	574.641	.759397
19	689.532	.838555	9	626.849	.797163	60	573.686	.758674
20	688.156	.837687	10	625.712	.796374			

TABLE XXVI.—RADII AND LOGARITHMS.

Deg. D.	Radius. R.	Loga- rithm. log R.	Deg. D.	Radius. R.	Loga- rithm. log R.	Deg. D.	Radius. R.	Loga- rithm. log R.
10°	573.686	2.758674	11°			13°		
2'	571.784	.757232	40'	491.956	2.691926	20'	430.690	2.634164
4	569.896	.755796	42	490.559	.690692	22	429.620	.633085
6	568.020	.754364	44	489.171	.689460	24	428.557	.632008
8	566.156	.752937	46	487.790	.688233	26	427.498	.630934
			48	486.417	.687008	28	426.445	.629863
10	564.305	2.751514	50	485.051	2.685788	30	425.396	2.628794
12	562.466	.750096	52	483.694	.684570	32	424.354	.627728
14	560.638	.748683	54	482.344	.683357	34	423.316	.626665
16	558.823	.747274	56	481.001	.682146	36	422.283	.625604
18	557.019	.745870	58	479.666	.680939	38	421.256	.624546
			60	478.339	.679735			
20	555.227	2.744471	12°	478.339	2.679735	40	420.233	2.623490
22	553.447	.743076	2'	477.018	.678535	42	419.215	.622437
24	551.678	.741686	4	475.705	.677338	44	418.203	.621387
26	549.920	.740300	6	474.400	.676145	46	417.195	.620339
28	548.174	.738918	8	473.102	.674954	48	416.192	.619294
30	546.438	2.737541	10	471.810	2.673767	50	415.194	2.618251
32	544.714	.736169	12	470.526	.672584	52	414.201	.617211
34	543.001	.734800	14	469.249	.671403	54	413.212	.616173
36	541.298	.733436	16	467.978	.670226	56	412.229	.615138
38	539.606	.732077	18	466.715	.669052	58	411.250	.614106
						60	410.275	.613075
40	537.924	2.730721	20	465.459	2.667881	14°	410.275	2.613075
42	536.253	.729370	22	464.209	.666713	2'	409.306	.612048
44	534.593	.728023	24	462.966	.665549	4	408.341	.611023
46	532.943	.726681	26	461.729	.664387	6	407.308	.610000
48	531.303	.725342	28	460.500	.663229	8	406.424	.608980
50	529.673	2.724008	30	459.276	2.662074	10	405.473	2.607962
52	528.053	.722677	32	458.060	.660922	12	404.526	.606946
54	526.443	.721351	34	456.850	.659773	14	403.583	.605933
56	524.843	.720029	36	455.646	.658628	16	402.645	.604923
58	523.252	.718711	38	454.449	.657485	18	401.712	.603914
11°	521.671	2.717397	40	453.259	2.656345	20	400.782	2.602908
2'	520.100	.716087	42	452.073	.655208	22	399.857	.601905
4	518.539	.714781	44	450.894	.654075	24	398.937	.600904
6	516.986	.713479	46	449.722	.652944	26	398.020	.599905
8	515.443	.712181	48	448.556	.651816	28	397.108	.598908
10	513.909	2.710887	50	447.395	2.650691	30	396.200	2.597914
12	512.385	.709596	52	446.241	.649570	32	395.296	.596922
14	510.869	.708310	54	445.093	.648451	34	394.396	.595933
16	509.363	.707027	56	443.951	.647335	36	393.501	.594945
18	507.865	.705748	58	442.814	.646221	38	392.609	.593960
20	506.376	2.704473	13°	441.684	2.645111	40	391.722	2.592978
22	504.896	.703202	2'	440.559	.644004	42	390.838	.591997
24	503.425	.701934	4	439.440	.642899	44	389.959	.591019
26	501.962	.700671	6	438.326	.641798	46	389.084	.590043
28	500.507	.699410	8	437.219	.640699	48	388.212	.589069
30	499.061	2.698154	10	436.117	2.639603	50	387.345	2.588097
32	497.624	.696901	12	435.020	.638510	52	386.481	.587128
34	496.195	.695652	14	433.929	.637419	54	385.621	.586161
36	494.774	.694407	16	432.844	.636331	56	384.765	.585196
38	493.361	.693165	18	431.764	.635246	58	383.913	.584233

TABLE XXVI.—RADII AND LOGARITHMS.

Deg. D.	Radius. R.	Loga- rithm. log R.	Deg. D.	Radius. R.	Loga- rithm. log R.	Deg. D.	Radius. R.	Loga- rithm. log R.
15°	383.065	2.583272	16°			18°		
2'	382.220	.582314	40'	344.990	2.537806	20'	313.860	2.496736
4	381.380	.581358	42	344.306	.536945	22	313.295	.495953
6	380.543	.580403	44	343.625	.536085	24	312.732	.495173
8	379.709	.579451	46	342.947	.535227	26	312.172	.494393
			48	342.271	.534370	28	311.613	.493616
10	378.880	2.578501	50	341.598	2.533516	30	311.056	2.492839
12	378.054	.577553	52	340.928	.532663	32	310.502	.492064
14	377.231	.576608	54	340.260	.531811	34	309.949	.491291
16	376.412	.575664	56	339.595	.530962	36	309.399	.490518
18	375.597	.574722	58	338.933	.530114	38	308.850	.489748
20	374.786	2.573783	17°	338.273	2.529268	40	308.303	2.488978
22	373.977	.572845	2'	337.616	.528424	42	307.759	.488210
24	373.173	.571910	4	336.962	.527581	44	307.216	.487444
26	372.372	.570977	6	336.310	.526740	46	306.675	.486679
28	371.574	.570045	8	335.660	.525900	48	306.136	.485915
30	370.780	2.569116	10	335.013	2.525062	50	305.599	2.485152
32	369.989	.568189	12	334.369	.524226	52	305.064	.484391
34	369.202	.567264	14	333.727	.523392	54	304.531	.483632
36	368.418	.566340	16	333.088	.522559	56	304.000	.482873
38	367.637	.565419	18	332.451	.521728	58	303.470	.482116
40	366.859	2.564500	20	331.816	2.520898	19°	302.943	2.481361
42	366.085	.563582	22	331.184	.520070	2'	302.417	.480607
44	365.315	.562667	24	330.555	.519244	4	301.893	.479854
46	364.547	.561754	26	329.928	.518419	6	301.371	.479102
48	363.783	.560843	28	329.303	.517596	8	300.851	.478352
50	363.022	2.559933	30	328.689	2.516774	10	300.333	2.477603
52	362.264	.559026	32	328.061	.515954	12	299.816	.476855
54	361.510	.558120	34	327.443	.515136	14	299.302	.476109
56	360.758	.557216	36	326.828	.514319	16	298.789	.475364
58	360.010	.556315	38	326.215	.513504	18	298.278	.474621
60	359.265	.555415	40	325.604	2.512690	20	297.768	2.473878
16°	359.265	2.555415	42	324.996	.511878	22	297.260	.473137
2'	358.523	.554517	44	324.390	.511067	24	296.755	.472398
4	357.784	.553621	46	323.786	.510258	26	296.250	.471659
6	357.048	.552727	48	323.184	.509451	28	295.748	.470922
8	356.315	.551834	50	322.585	2.508645	30	295.247	2.470186
10	355.585	2.550944	52	321.989	.507840	32	294.748	.469452
12	354.859	.550055	54	321.394	.507037	34	294.251	.468718
14	354.135	.549169	56	320.801	.506236	36	293.756	.467986
16	353.414	.548284	58	320.211	.505436	38	293.262	.467256
18	352.696	.547401	60	319.623	.504638	40	292.770	2.466526
20	351.981	2.546519	18°	319.623	2.504638	42	292.279	.465798
22	351.269	.545640	2'	319.037	.503841	44	291.790	.465071
24	350.560	.544762	4	318.453	.503045	46	291.303	.464345
26	349.854	.543887	6	317.871	.502251	48	290.818	.463621
28	349.150	.543013	8	317.292	.501459	50	290.334	2.462897
30	348.450	2.542140	10	316.715	2.500668	52	289.851	.462175
32	347.752	.541270	12	316.139	.499879	54	289.371	.461455
34	347.057	.540401	14	315.566	.499091	56	288.892	.460735
36	346.365	.539535	16	314.993	.498304	58	288.414	.460017
	345.676	.538670	18	314.426	.497519	60	287.939	.459300

TABLE XXVI.—RADII AND LOGARITHMS.

Deg. D.	Radius. R.	Loga- rithm. log R.	Deg. D.	Radius. R.	Loga- rithm. log R.	Deg. D.	Radius. R.	Loga- rithm. log R.
20°	287.939	2.459300	26°	222.271	2.346882	34°	171.015	2.233035
10'	285.583	.455733	10'	220.879	.344155	20'	169.404	.228924
20	283.267	.452195	20	219.506	.341446	40	167.825	.224855
30	280.988	.448688	30	218.150	.338755	35°	166.275	.220828
40	278.746	.445209	40	216.811	.336081	20'	164.756	.216842
50	276.541	.441759	50	215.489	.333424	40	163.266	.212895
21°	274.370	2.438337	27°	214.183	2.330785	36°	161.803	2.208988
10'	272.234	.434943	10'	212.893	.328162	20'	160.368	.205119
20	270.132	.431576	20	211.620	.325556	40	158.960	.201288
30	268.062	.428235	30	210.362	.322967	37°	157.577	.197494
40	266.024	.424921	40	209.119	.320393	20'	156.220	.193736
50	264.018	.421633	50	207.891	.317836	40	154.887	.190014
22°	262.042	2.418371	28°	206.678	2.315295	38°	153.578	2.186328
10'	260.098	.415134	10'	205.480	.312769	30'	151.657	.180863
20	258.180	.411922	20	204.296	.310259	39°	149.787	.175475
30	256.292	.408734	30	203.125	.307764	30'	147.965	.170160
40	254.431	.405571	40	201.969	.305285	40°	146.190	.164918
50	252.599	.402431	50	200.826	.302820	30	144.460	.159747
23°	250.793	2.399315	29°	199.696	2.300370	41°	142.773	2.154645
10'	249.013	.396222	10'	198.580	.297935	30'	141.127	.149610
20	247.258	.393151	20	197.476	.295515	42°	139.521	.144641
30	245.529	.390103	30	196.385	.293108	30'	137.955	.139736
40	243.825	.387077	40	195.306	.290716	43°	136.425	.134895
50	242.144	.384074	50	194.240	.288338	30'	134.932	.130114
24°	240.487	2.381091	30°	193.185	2.285974	44°	133.473	2.125395
10'	238.853	.378130	20'	191.111	.281286	30'	132.049	.120734
20	237.241	.375190	40	189.083	.276652	45°	130.656	.116130
30	235.652	.372270	31°	187.099	.272071	30'	129.296	.111584
40	234.084	.369371	20'	185.158	.267541	46°	127.965	.107092
50	232.537	.366492	40	183.258	.263062	30'	126.664	.102655
25°	231.011	2.363633	32°	181.398	2.258632	47°	125.392	2.098270
10'	229.506	.360794	20'	179.577	.254250	30'	124.148	.093938
20	228.020	.357974	40	177.794	.249916	48°	122.930	.089657
30	226.555	.355173	33°	176.047	.245628	30'	121.738	.085425
40	225.108	.352391	20'	174.336	.241386	49°	120.571	.081243
50	223.680	.349627	40	172.659	.237188	30'	119.429	.077109
						50°	118.310	2.073022

TABLE XXVII.—CORRECTIONS, TANGENTS AND EXTERNALS

Ang. A.	FOR TANGENTS, ADD						Ang. A.	FOR EXTERNALS, ADD					
	5° Cur.	10° Cur.	15° Cur.	20° Cur.	25° Cur.	30° Cur.		5° Cur.	10° Cur.	15° Cur.	20° Cur.	25° Cur.	30° Cur.
10	.03	.06	.09	.13	.16	.19	10	.001	.003	.004	.006	.007	.008
20	.06	.13	.19	.26	.32	.39	20	.006	.011	.017	.022	.028	.034
30	.10	.19	.29	.39	.49	.59	30	.013	.025	.038	.051	.065	.078
40	.13	.26	.40	.53	.67	.80	40	.023	.046	.070	.093	.117	.141
50	.17	.34	.51	.68	.85	1.02	50	.037	.075	.116	.151	.189	.227
60	.21	.42	.63	.84	1.05	1.27	60	.056	.112	.168	.225	.283	.340
70	.25	.51	.76	1.02	1.28	1.54	70	.080	.159	.240	.321	.403	.485
80	.30	.61	.91	1.22	1.53	1.84	80	.110	.220	.332	.445	.558	.671
90	.36	.72	1.09	1.45	1.83	2.20	90	.149	.299	.450	.603	.756	.910
100	.43	.86	1.30	1.74	2.18	2.62	100	.200	.401	.604	.809	1.015	1.221
110	.51	1.03	1.56	2.08	2.61	3.14	110	.268	.536	.806	1.082	1.355	1.633
120	.62	1.25	1.93	2.52	3.16	3.81	120	.360	.721	1.086	1.456	1.825	2.197

TABLE XXVIII.—TANGENTS AND EXTERNALS TO A 1° CURVE.

Angle. A.	Tan- gent. T.	Exter- nal. Q.	Angle. A.	Tan- gent. T.	Exter- nal. Q.	Angle. A.	Tan- gent. T.	Exter- nal. Q.
1°	50.00	.218	10°	501.28	21.887	19°	958.81	79.671
10'	58.34	.297	10'	509.68	22.624	10'	967.38	81.092
20	66.67	.388	20	518.08	23.375	20	975.96	81.525
30	75.01	.491	30	526.48	24.138	30	984.53	83.972
40	83.34	.606	40	534.89	24.913	40	993.12	85.431
50	91.68	.733	50	543.29	25.700	50	1001.7	86.904
2°	100.01	.873	11°	551.70	26.500	20°	1010.3	88.389
10'	108.35	1.024	10'	560.11	27.313	10'	1018.9	89.888
20	116.68	1.188	20	568.53	28.137	20	1027.5	91.399
30	125.02	1.364	30	576.95	28.974	30	1036.1	92.924
40	133.36	1.552	40	585.36	29.824	40	1044.7	94.462
50	141.70	1.752	50	593.79	30.686	50	1053.3	96.013
3°	150.04	1.964	12°	602.21	31.561	21°	1061.9	97.577
10'	158.38	2.188	10'	610.64	32.447	10'	1070.6	99.155
20	166.72	2.425	20	619.07	33.347	20	1079.2	100.75
30	175.06	2.674	30	627.50	34.259	30	1087.8	102.35
40	183.40	2.934	40	635.93	35.183	40	1096.4	103.97
50	191.74	3.207	50	644.37	36.120	50	1105.1	105.60
4°	200.08	3.492	13°	652.81	37.070	22°	1113.7	107.24
10'	208.43	3.790	10'	661.25	38.031	10'	1122.4	108.90
20	216.77	4.099	20	669.70	39.006	20	1131.0	110.57
30	225.12	4.421	30	678.15	39.993	30	1139.7	112.25
40	233.47	4.755	40	686.60	40.992	40	1148.4	113.95
50	241.81	5.100	50	695.06	42.004	50	1157.0	115.66
5°	250.16	5.459	14°	703.51	43.029	23°	1165.7	117.38
10'	258.51	5.829	10'	711.97	44.066	10'	1174.4	119.12
20	266.86	6.211	20	720.44	45.116	20	1183.1	120.87
30	275.21	6.606	30	728.90	46.178	30	1191.8	122.63
40	283.57	7.013	40	737.37	47.253	40	1200.5	124.41
50	291.92	7.432	50	745.85	48.341	50	1209.2	126.20
6°	300.28	7.863	15°	754.32	49.441	24°	1217.9	128.00
10'	308.64	8.307	10'	762.80	50.554	10'	1226.6	129.82
20	316.99	8.762	20	771.29	51.679	20	1235.3	131.65
30	325.35	9.230	30	779.77	52.818	30	1244.0	133.50
40	333.71	9.710	40	788.26	53.969	40	1252.8	135.35
50	342.08	10.202	50	796.75	55.132	50	1261.5	137.23
7°	350.44	10.707	16°	805.25	56.309	25°	1270.2	139.11
10'	358.81	11.224	10'	813.75	57.498	10'	1279.0	141.01
20	367.17	11.753	20	822.25	58.699	20	1287.7	142.93
30	375.54	12.294	30	830.76	59.914	30	1296.5	144.85
40	383.91	12.847	40	839.27	61.141	40	1305.3	146.79
50	392.28	13.413	50	847.78	62.381	50	1314.0	148.75
8°	400.66	13.991	17°	856.30	63.634	26°	1322.8	150.71
10'	409.03	14.582	10'	864.82	64.900	10'	1331.6	152.69
20	417.41	15.184	20	873.35	66.178	20	1340.4	154.69
30	425.79	15.799	30	881.88	67.470	30	1349.2	156.70
40	434.17	16.426	40	890.41	68.774	40	1358.0	158.72
50	442.55	17.065	50	898.95	70.091	50	1366.8	160.76
9°	450.93	17.717	18°	907.49	71.421	27°	1375.6	162.81
10'	459.32	18.381	10'	916.03	72.764	10'	1384.4	164.86
20	467.71	19.058	20	924.58	74.119	20	1393.2	166.95
30	476.10	19.746	30	933.13	75.488	30	1402.0	169.04
40	484.49	20.447	40	941.69	76.869	40	1410.9	171.15
50	492.88	21.161	50	950.25	78.264	50	1419.7	173.27

TABLE XXVIII.—TANGENTS AND EXTERNALS TO A 1° CURVE

Angle. A.	Tan- gent. T.	Exter- nal. Q.	Angle. A.	Tan- gent. T.	Exter- nal. Q.	Angle. A.	Tan- gent. T.	Exter- nal. Q.
28°	1428.6	175.41	37°	1917.1	312.22	46°	2432.1	494.82
10'	1437.4	177.55	10'	1926.4	315.17	10'	2441.9	498.67
20	1446.3	179.72	20	1935.7	318.13	20	2451.8	502.54
30	1455.1	181.89	30	1945.0	321.11	30	2461.7	506.42
40	1464.0	184.08	40	1954.3	324.11	40	2471.5	510.33
50	1472.9	186.29	50	1963.6	327.12	50	2481.4	514.25
29°	1481.8	188.51	38°	1972.9	330.15	47°	2491.3	518.20
10'	1490.7	190.74	10'	1982.2	333.19	10'	2501.2	522.16
20	1499.6	192.99	20	1991.5	336.25	20	2511.2	526.13
30	1508.5	195.25	30	2000.9	339.32	30	2521.1	530.13
40	1517.4	197.53	40	2010.2	342.41	40	2531.1	534.15
50	1526.3	199.82	50	2019.6	345.52	50	2541.0	538.18
30°	1535.3	202.12	39°	2029.0	348.64	48°	2551.0	542.23
10'	1544.2	204.44	10'	2038.4	351.78	10'	2561.0	546.30
20	1553.1	206.77	20	2047.8	354.94	20	2571.0	550.39
30	1562.1	209.12	30	2057.2	358.11	30	2581.0	554.50
40	1571.0	211.48	40	2066.6	361.29	40	2591.1	558.63
50	1580.0	213.86	50	2076.0	364.50	50	2601.1	562.77
31°	1589.0	216.25	40°	2085.4	367.72	49°	2611.2	566.94
10'	1598.0	218.66	10'	2094.9	370.95	10'	2621.2	571.12
20	1606.9	221.08	20	2104.3	374.20	20	2631.3	575.32
30	1615.9	223.51	30	2113.8	377.47	30	2641.4	579.54
40	1624.9	225.96	40	2123.3	380.76	40	2651.5	583.78
50	1633.9	228.42	50	2132.7	384.06	50	2661.6	588.04
32°	1643.0	230.90	41°	2142.2	387.38	50°	2671.8	592.32
10'	1652.0	233.39	10'	2151.7	390.71	10'	2681.9	596.62
20	1661.0	235.90	20	2161.2	394.06	20	2692.1	600.93
30	1670.0	238.43	30	2170.8	397.43	30	2702.3	605.27
40	1679.1	240.96	40	2180.3	400.82	40	2712.5	609.62
50	1688.1	243.52	50	2189.9	404.22	50	2722.7	614.00
33°	1697.2	246.08	42°	2199.4	407.64	51°	2732.9	618.39
10'	1706.3	248.66	10'	2209.0	411.07	10'	2743.1	622.81
20	1715.3	251.26	20	2218.6	414.52	20	2753.4	627.24
30	1724.4	253.87	30	2228.1	417.99	30	2763.7	631.69
40	1733.5	256.50	40	2237.7	421.48	40	2773.9	636.17
50	1742.6	259.14	50	2247.3	424.98	50	2784.2	640.66
34°	1751.7	261.80	43°	2257.0	428.50	52°	2794.5	645.17
10'	1760.8	264.47	10'	2266.6	432.04	10'	2804.9	649.70
20	1770.0	267.16	20	2276.2	435.59	20	2815.2	654.25
30	1779.1	269.86	30	2285.9	439.16	30	2825.6	658.83
40	1788.2	272.58	40	2295.6	442.75	40	2835.9	663.42
50	1797.4	275.31	50	2305.2	446.35	50	2846.3	668.03
35°	1806.6	278.05	44°	2314.9	449.98	53°	2856.7	672.66
10'	1815.7	280.82	10'	2324.6	453.62	10'	2867.1	677.32
20	1824.9	283.60	20	2334.3	457.27	20	2877.5	681.99
30	1834.1	286.39	30	2344.1	460.95	30	2888.0	686.68
40	1843.3	289.20	40	2353.8	464.64	40	2898.4	691.40
50	1852.5	292.02	50	2363.5	468.35	50	2908.9	696.13
36°	1861.7	294.86	45°	2373.3	472.08	54°	2919.4	700.89
10'	1870.9	297.72	10'	2383.1	475.82	10'	2929.9	705.66
20	1880.1	300.59	20	2392.8	479.59	20	2940.4	710.46
30	1889.4	303.47	30	2402.6	483.37	30	2951.0	715.28
40	1898.6	306.37	40	2412.4	487.17	40	2961.5	720.11
50	1907.9	309.29	50	2422.3	490.98	50	2972.1	724.9

TABLE XXVIII.—TANGENTS AND EXTERNALS TO A 1° CURVE

Angle. A.	Tan- gent. T.	Exter- nal. Q.	Angle. A.	Tan- gent. T.	Exter- nal. Q.	Angle. A.	Tan- gent. T.	Exter- nal. Q.
55°	2982.7	729.85	64°	3580.3	1026.6	73°	4239.7	1398.0
10'	2993.3	734.76	10'	3591.9	1032.8	10'	4252.6	1405.7
20	3003.9	739.68	20	3603.5	1039.0	20	4265.6	1413.5
30	3014.5	744.62	30	3615.1	1045.2	30	4278.5	1421.2
40	3025.2	749.59	40	3626.8	1051.4	40	4291.5	1429.0
50	3035.8	754.57	50	3638.5	1057.7	50	4304.6	1436.8
56°	3046.5	759.58	65°	3650.2	1063.9	74°	4317.6	1444.6
10'	3057.2	764.61	10'	3661.9	1070.2	10'	4330.7	1452.5
20	3067.9	769.66	20	3673.7	1076.6	20	4343.8	1460.4
30	3078.7	774.73	30	3685.4	1082.9	30	4356.9	1468.4
40	3089.4	779.83	40	3697.2	1089.3	40	4370.1	1476.4
50	3100.2	784.94	50	3709.0	1095.7	50	4383.3	1484.4
57°	3110.9	790.08	66°	3720.9	1102.2	75°	4396.5	1492.4
10'	3121.7	795.24	10'	3732.7	1108.6	10'	4409.8	1500.5
20	3132.6	800.42	20	3744.6	1115.1	20	4423.1	1508.6
30	3143.4	805.62	30	3756.5	1121.7	30	4436.4	1516.7
40	3154.2	810.85	40	3768.5	1128.2	40	4449.7	1524.9
50	3165.1	816.10	50	3780.4	1134.8	50	4463.1	1533.1
58°	3176.0	821.37	67°	3792.4	1141.4	76°	4476.5	1541.4
10'	3186.9	826.66	10'	3804.4	1148.0	10'	4489.9	1549.7
20	3197.8	831.98	20	3816.4	1154.7	20	4503.4	1558.0
30	3208.8	837.31	30	3828.4	1161.3	30	4516.9	1566.3
40	3219.7	842.67	40	3840.5	1168.1	40	4530.4	1574.7
50	3230.7	848.06	50	3852.6	1174.8	50	4544.0	1583.1
59°	3241.7	853.46	68°	3864.7	1181.6	77°	4557.6	1591.6
10'	3252.7	858.89	10'	3876.8	1188.4	10'	4571.2	1600.1
20	3263.7	864.34	20	3889.0	1195.2	20	4584.8	1608.6
30	3274.8	869.82	30	3901.2	1202.0	30	4598.5	1617.1
40	3285.8	875.32	40	3913.4	1208.9	40	4612.2	1625.7
50	3296.9	880.84	50	3925.6	1215.8	50	4626.0	1634.4
60°	3308.0	886.38	69°	3937.9	1222.7	78°	4639.8	1643.0
10'	3319.1	891.95	10'	3950.2	1229.7	10'	4653.6	1651.7
20	3330.3	897.54	20	3962.5	1236.7	20	4667.4	1660.5
30	3341.4	903.15	30	3974.8	1243.7	30	4681.3	1669.2
40	3352.6	908.79	40	3987.2	1250.8	40	4695.2	1678.1
50	3363.8	914.45	50	3999.5	1257.9	50	4709.2	1686.9
61°	3375.0	920.14	70°	4011.9	1265.0	79°	4723.2	1695.8
10'	3386.3	925.85	10'	4024.4	1272.1	10'	4737.2	1704.7
20	3397.5	931.58	20	4036.8	1279.3	20	4751.2	1713.7
30	3408.8	937.34	30	4049.3	1286.5	30	4765.3	1722.7
40	3420.1	943.12	40	4061.8	1293.6	40	4779.4	1731.7
50	3431.4	948.92	50	4074.4	1300.9	50	4793.6	1740.8
62°	3442.7	954.75	71°	4086.9	1308.2	80°	4807.7	1749.9
10'	3454.1	960.60	10'	4099.5	1315.6	10'	4822.0	1759.0
20	3465.4	966.48	20	4112.1	1322.9	20	4836.2	1768.2
30	3476.8	972.38	30	4124.8	1330.3	30	4850.5	1777.4
40	3488.3	978.31	40	4137.4	1337.7	40	4864.8	1786.7
50	3499.7	984.27	50	4150.1	1345.1	50	4879.2	1796.0
63°	3511.1	990.24	72°	4162.8	1352.6	81°	4893.6	1805.3
10'	3522.6	996.24	10'	4175.6	1360.1	10'	4908.0	1814.7
20	3534.1	1002.3	20	4188.5	1367.6	20	4922.5	1824.1
30	3545.6	1008.3	30	4201.2	1375.2	30	4937.0	1833.6
40	3557.2	1014.4	40	4214.0	1382.8	40	4951.5	1843.1
50	3568.7	1020.5	50	4226.8	1390.4	50	4966.1	1852.6

TABLE XXVIII.—TANGENTS AND EXTERNALS TO A 1° CURVE

Angle. A.	Tan- gent. T.	Exter- nal. Q.	Angle. A.	Tan- gent. T.	Exter- nal. Q.	Angle. A.	Tan- gent. T.	Exter- nal. Q.
82°	4980.7	1862.2	91°	5830.5	2444.9	100°	6828.3	3184.1
10'	4995.4	1871.8	10'	5847.5	2457.1	10'	6848.5	3199.6
20	5010.0	1881.5	20	5864.6	2469.3	20	6868.8	3215.1
30	5024.8	1891.2	30	5881.7	2481.5	30	6889.2	3230.8
40	5039.5	1900.9	40	5898.8	2493.8	40	6909.6	3246.5
50	5054.3	1910.7	50	5916.0	2506.1	50	6930.1	3262.3
83°	5069.2	1920.5	92°	5933.2	2518.5	101°	6950.6	3278.1
10'	5084.0	1930.4	10'	5950.5	2531.0	10'	6971.3	3294.1
20	5099.0	1940.3	20	5967.9	2543.5	20	6992.0	3310.1
30	5113.9	1950.3	30	5985.3	2556.0	30	7012.7	3326.1
40	5128.9	1960.2	40	6002.7	2568.6	40	7033.6	3342.3
50	5143.9	1970.3	50	6020.2	2581.3	50	7054.5	3358.5
84°	5159.0	1980.4	93°	6037.8	2594.0	102°	7075.5	3374.9
10'	5174.1	1990.5	10'	6055.4	2606.8	10'	7096.6	3391.2
20	5189.3	2000.6	20	6073.1	2619.7	20	7117.8	3407.7
30	5204.4	2010.8	30	6090.8	2632.6	30	7139.0	3424.3
40	5219.7	2021.1	40	6108.6	2645.5	40	7160.3	3440.9
50	5234.9	2031.4	50	6126.4	2658.5	50	7181.7	3457.6
85°	5250.3	2041.7	94°	6144.3	2671.6	103°	7203.2	3474.4
10'	5265.6	2052.1	10'	6162.2	2684.7	10'	7224.7	3491.3
20	5281.0	2062.5	20	6180.2	2697.9	20	7246.3	3508.2
30	5296.4	2073.0	30	6198.3	2711.2	30	7268.0	3525.2
40	5311.9	2083.5	40	6216.4	2724.5	40	7289.8	3542.4
50	5327.4	2094.1	50	6234.6	2737.9	50	7311.7	3559.6
86°	5343.0	2104.7	95°	6252.8	2751.3	104°	7333.6	3576.8
10'	5358.6	2115.3	10'	6271.1	2764.8	10'	7355.6	3594.2
20	5374.2	2126.0	20	6289.4	2778.3	20	7377.8	3611.7
30	5389.9	2136.7	30	6307.9	2792.0	30	7399.9	3629.2
40	5405.6	2147.5	40	6326.3	2805.6	40	7422.2	3646.8
50	5421.4	2158.4	50	6344.8	2819.4	50	7444.6	3664.5
87°	5437.2	2169.2	96°	6363.4	2833.2	105°	7467.0	3682.3
10'	5453.1	2180.2	10'	6382.1	2847.0	10'	7489.6	3700.2
20	5469.0	2191.1	20	6400.8	2861.0	20	7512.2	3718.2
30	5484.9	2202.2	30	6419.5	2875.0	30	7534.9	3736.2
40	5500.9	2213.2	40	6438.4	2889.0	40	7557.7	3754.4
50	5517.0	2224.3	50	6457.3	2903.1	50	7580.5	3772.6
88°	5533.1	2235.5	97°	6476.2	2917.3	106°	7603.5	3791.0
10'	5549.2	2246.7	10'	6495.2	2931.6	10'	7626.6	3809.4
20	5565.4	2258.0	20	6514.3	2945.9	20	7649.7	3827.9
30	5581.6	2269.3	30	6533.4	2960.3	30	7672.9	3846.5
40	5597.8	2280.6	40	6552.6	2974.7	40	7696.3	3865.2
50	5614.2	2292.0	50	6571.9	2989.2	50	7719.7	3884.0
89°	5630.5	2303.5	98°	6591.2	3003.8	107°	7743.2	3902.9
10'	5646.9	2315.0	10'	6610.6	3018.4	10'	7766.8	3921.9
20	5663.4	2326.6	20	6630.1	3033.1	20	7790.5	3940.9
30	5679.9	2338.2	30	6649.6	3047.9	30	7814.3	3960.1
40	5696.4	2349.8	40	6669.2	3062.8	40	7838.1	3979.4
50	5713.0	2361.5	50	6688.8	3077.7	50	7862.1	3998.7
90°	5729.7	2373.3	99°	6708.6	3092.7	108°	7886.2	4018.2
10'	5746.3	2385.1	10'	6728.4	3107.7	10'	7910.4	4037.8
20	5763.1	2397.0	20	6748.2	3122.9	20	7934.6	4057.4
30	5779.9	2408.9	30	6768.1	3138.1	30	7959.0	4077.2
40	5796.7	2420.9	40	6788.1	3153.3	40	7983.5	4097.1
50	5813.6	2432.9	50	6808.2	3168.7	50	8008.0	4117

TABLE XXVIII.—TANGENTS AND EXTERNALS TO A 1° CURVE

Angle. A.	Tan- gent. T.	Exter- nal. Q.	Angle. A.	Tan- gent. T.	Exter- nal. Q.	Angle. A.	Tan- gent. T.	Exter- nal. Q.
109°	8032.7	4137.1	113°	8656.6	4651.3	117°	9349.9	5236.2
10'	8057.4	4157.3	10'	8684.0	4674.2	10'	9380.5	5262.3
20	8082.3	4177.5	20	8711.5	4697.2	20	9411.3	5288.6
30	8107.3	4197.9	30	8739.2	4720.3	30	9442.2	5315.0
40	8132.3	4218.4	40	8767.0	4743.6	40	9473.2	5341.5
50	8157.5	4239.0	50	8794.9	4766.9	50	9504.4	5368.2
110°	8182.8	4259.7	114°	8822.9	4790.4	118°	9535.7	5395.1
10'	8208.2	4280.5	10'	8851.0	4814.1	10'	9567.2	5422.1
20	8233.7	4301.4	20	8879.3	4837.8	20	9598.9	5449.2
30	8259.3	4322.4	30	8907.7	4861.7	30	9630.7	5476.5
40	8285.0	4343.6	40	8936.3	4885.7	40	9662.6	5504.0
50	8310.8	4364.8	50	8965.0	4909.9	50	9694.7	5531.7
111°	8336.7	4386.1	115°	8993.8	4934.1	119°	9727.0	5559.4
10'	8362.7	4407.6	10'	9022.7	4958.6	10'	9759.4	5587.4
20	8388.9	4429.2	20	9051.7	4983.1	20	9792.0	5615.5
30	8415.1	4450.9	30	9080.9	5007.8	30	9824.8	5643.8
40	8441.5	4472.7	40	9110.3	5032.6	40	9857.7	5672.3
50	8468.0	4494.6	50	9139.8	5057.6	50	9890.8	5700.9
112°	8494.6	4516.6	116°	9169.4	5082.7	120°	9924.0	5729.7
10'	8521.3	4538.8	10'	9199.1	5107.9	10'	9957.5	5758.6
20	8548.1	4561.1	20	9229.0	5133.3	20	9991.0	5787.7
30	8575.0	4583.4	30	9259.0	5158.8	30	10025.0	5817.0
40	8602.1	4606.0	40	9289.2	5184.5	40	10059.0	5846.5
50	8629.3	4628.6	50	9319.5	5210.3	50	10093.0	5876.1

TABLE XXVII.
LOGARITHMS OF NUMBERS
FROM 1 TO 10000.

A

TABLE,

CONTAINING

THE LOGARITHMS OF NUMBERS

FROM 1 TO 10,000.

NUMBERS FROM 1 TO 100 AND THEIR LOGARITHMS,

WITH THEIR INDICES.

No.	Logarithm.	No.	Logarithm.	No.	Logarithm.	No.	Logarithm.	No.	Logarithm.
1	0.000000	21	1.322219	41	1.612784	61	1.785330	81	1.908495
2	0.301030	22	1.342423	42	1.623249	62	1.792392	82	1.913814
3	0.477121	23	1.361728	43	1.633468	63	1.799341	83	1.919078
4	0.602060	24	1.380211	44	1.643453	64	1.806180	84	1.924279
5	0.698970	25	1.397940	45	1.653213	65	1.812913	85	1.929419
6	0.778151	26	1.414973	46	1.662758	66	1.819544	86	1.934498
7	0.845098	27	1.431364	47	1.672098	67	1.826075	87	1.939519
8	0.903090	28	1.447158	48	1.681241	68	1.832509	88	1.944483
9	0.954243	29	1.462398	49	1.690196	69	1.838849	89	1.949390
10	1.000000	30	1.477121	50	1.698970	70	1.845098	90	1.954243
11	1.041393	31	1.491362	51	1.707570	71	1.851258	91	1.959041
12	1.079181	32	1.505150	52	1.716003	72	1.857332	92	1.963788
13	1.113943	33	1.518514	53	1.724276	73	1.863323	93	1.968483
14	1.146128	34	1.531479	54	1.732394	74	1.869232	94	1.973128
15	1.176091	35	1.544068	55	1.740363	75	1.875061	95	1.977724
16	1.204120	36	1.556303	56	1.748188	76	1.880814	96	1.982271
17	1.230449	37	1.568292	57	1.755875	77	1.886491	97	1.986772
18	1.255273	38	1.579784	58	1.763428	78	1.892095	98	1.991226
19	1.278754	39	1.591065	59	1.770852	79	1.897627	99	1.995635
20	1.301030	40	1.603060	60	1.778151	80	1.903090	100	2.000000

NOTE.—In the following part of the Table, the characteristics are omitted, as they can be very easily supplied. Thus, the characteristic of the logarithm of every integer number, consisting only of one number, is 0; of two figures, 1; of three figures, 2; of four figures, 3; being always a unit less than the number of figures contained in the integer number.

No.	0	1	2	3	4	5	6	7	8	9	Diff.
100	000000	000434	000868	001301	001734	002166	002598	003029	003461	003891	432
1	4321	4751	5181	5609	6038	6466	6894	7321	7748	8174	428
2	8600	9026	9451	9876	010300	010724	011147	011570	011993	012415	424
3	012837	013259	013680	014100	4521	4940	5360	5779	6197	6616	420
4	7033	7451	7868	8284	8700	9116	9532	9947	020361	020775	416
5	021189	021603	022016	022428	022841	023252	023664	024075	4486	4896	412
6	5306	5715	6125	6533	6942	7350	7757	8164	8571	8978	408
7	9384	9789	030195	030600	031004	031408	031812	032216	032619	033021	404
8	033424	033826	4227	4628	5029	5430	5830	6230	6629	7028	400
9	7426	7825	8223	8620	9017	9414	9811	040207	040602	040998	397
110	041393	041787	042182	042576	042969	043362	043755	044148	044540	044932	393
1	5323	5714	6105	6495	6885	7275	7664	8053	8442	8830	390
2	9218	9606	9993	050380	050766	051153	051538	051924	052309	052694	386
3	053078	053463	053846	4230	4613	4996	5378	5760	6142	6524	383
4	6905	7286	7666	8046	8426	8805	9185	9563	9942	060320	379
5	060698	061075	061452	061829	062206	062582	062958	063333	063709	4083	376
6	4458	4832	5206	5580	5953	6326	6699	7071	7443	7815	373
7	8186	8557	8928	9298	9668	070038	070407	070776	071145	071514	370
8	071882	072250	072617	072985	073352	3718	4085	4451	4816	5182	366
9	5547	5912	6276	6640	7004	7368	7731	8094	8457	8819	363
120	079181	079543	079904	080266	080626	080987	081347	081707	082067	082426	360
1	082785	083144	083503	3861	4219	4576	4934	5291	5647	6004	357
2	6360	6716	7071	7426	7781	8136	8490	8845	9198	9552	355
3	9905	090258	090611	090963	091315	091667	092018	092370	092721	093071	352
4	093422	3772	4122	4471	4820	5169	5518	5866	6215	6562	349
5	6910	7257	7604	7951	8298	8644	8990	9335	9681	100026	346
6	100371	100715	101059	101403	101747	102091	102434	102777	103119	3462	343
7	3804	4146	4487	4828	5169	5510	5851	6191	6531	6871	341
8	7210	7549	7888	8227	8565	8903	9241	9579	9916	110253	338
9	110590	110926	111263	111599	111934	112270	112605	112940	113275	3609	335
130	113943	114277	114611	114944	115278	115611	115943	116276	116608	116940	333
1	7271	7603	7934	8265	8596	8926	9256	9586	9915	120245	330
2	120574	120903	121231	121560	121888	122216	122544	122871	123198	3525	328
3	3852	4178	4504	4830	5156	5481	5806	6131	6456	6781	325
4	7105	7429	7753	8076	8399	8722	9045	9368	9690	130012	323
5	130334	130655	130977	131298	131619	131939	132260	132580	132900	3219	321
6	3539	3858	4177	4496	4814	5133	5451	5769	6086	6403	318
7	6721	7037	7354	7671	7987	8303	8618	8934	9249	9564	316
8	9879	140194	140508	140822	141136	141450	141763	142076	142389	142702	314
9	143015	3327	3639	3951	4263	4574	4885	5196	5507	5818	311
140	146128	146438	146748	147058	147367	147676	147985	148294	148603	148911	309
1	9219	9527	9835	150142	150449	150756	151063	151370	151676	151982	307
2	152288	152594	152900	3205	3510	3815	4120	4424	4728	5032	305
3	5336	5640	5943	6246	6549	6852	7154	7457	7759	8061	303
4	8362	8664	8965	9266	9567	9868	160168	160469	160769	161068	301
5	161368	161667	161967	162266	162564	162863	3161	3460	3758	4055	299
6	4353	4650	4947	5244	5541	5838	6134	6430	6726	7022	297
7	7317	7613	7908	8203	8497	8792	9086	9380	9674	9968	295
8	170262	170555	170848	171141	171434	171726	172019	172311	172603	172895	293
9	3186	3478	3769	4060	4351	4641	4932	5222	5512	5802	291
150	176091	176381	176670	176959	177248	177536	177825	178113	178401	178689	289
1	8977	9264	9552	9839	180126	180413	180699	180986	181272	181558	287
2	181844	182129	182415	182700	2985	3270	3555	3839	4123	4407	285
3	4691	4975	5259	5542	5825	6108	6391	6674	6956	7239	283
4	7521	7803	8084	8366	8647	8928	9209	9490	9771	190051	281
5	190332	190612	190892	191171	191451	191730	192010	192289	192567	2546	279
6	3125	3403	3681	3959	4237	4514	4792	5069	5346	5623	278
7	5900	6176	6453	6729	7005	7281	7556	7832	8107	8382	276
8	8657	8932	9206	9481	9755	200029	200303	200577	200850	201124	274
9	201397	201670	201943	202216	202488	2761	3033	3305	3577	3848	272

No.	0	1	2	3	4	5	6	7	8	9	Diff.
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No.	0	1	2	3	4	5	6	7	8	9	Diff.
160	204120	204391	204663	204934	205204	205475	205746	206016	206286	206556	271
1	6836	7096	7365	7634	7904	8173	8441	8710	8979	9247	269
2	9515	9783	210051	210319	210586	210853	211121	211388	211654	211921	267
3	212188	212454	2720	2986	3252	3518	3783	4049	4314	4579	266
4	4844	5109	5373	5638	5902	6166	6430	6694	6957	7221	264
5	7484	7747	8010	8273	8536	8798	9060	9323	9585	9846	262
6	220108	220370	220631	220892	221153	221414	221675	221936	222196	222456	261
7	2716	2976	3236	3496	3755	4015	4274	4533	4792	5051	259
8	5309	5568	5826	6084	6342	6600	6858	7115	7372	7630	258
9	7887	8144	8400	8657	8913	9170	9426	9682	9938	230193	256
170	230449	230704	230960	231215	231470	231724	231979	232234	232488	232742	255
1	2996	3250	3504	3757	4011	4264	4517	4770	5023	5276	253
2	5528	5781	6033	6285	6537	6789	7041	7292	7544	7795	252
3	8046	8297	8548	8799	9049	9299	9550	9800	240050	240300	250
4	240549	240799	241048	241297	241546	241795	242044	242293	2541	2790	249
5	3038	3286	3534	3782	4030	4277	4525	4772	5019	5266	248
6	5513	5759	6006	6252	6499	6745	6991	7237	7482	7728	246
7	7973	8219	8464	8709	8954	9198	9443	9687	9932	250176	245
8	250420	250664	250908	251151	251395	251638	251881	252125	252368	2610	243
9	2853	3096	3338	3580	3822	4064	4306	4548	4790	5031	242
180	255273	255514	255755	255996	256237	256477	256718	256958	257198	257439	241
1	7679	7918	8158	8398	8637	8877	9116	9355	9594	9833	239
2	260071	260310	260548	260787	261025	261263	261501	261739	261976	262214	238
3	2451	2688	2925	3162	3399	3636	3873	4109	4346	4582	237
4	4818	5054	5290	5525	5761	5996	6232	6467	6702	6937	235
5	7172	7406	7641	7875	8110	8344	8578	8812	9046	9279	234
6	9513	9746	9980	270213	270446	270679	270912	271144	271377	271609	233
7	271842	272074	272306	2538	2770	3001	3233	3464	3696	3927	232
8	4158	4389	4620	4850	5081	5311	5542	5772	6002	6232	230
9	6462	6692	6921	7151	7380	7609	7838	8067	8296	8525	229
190	278754	278982	279211	279439	279667	279895	280123	280351	280578	280806	228
1	281033	281261	281488	281715	281942	282169	2396	2622	2849	3075	227
2	3301	3527	3753	3979	4205	4431	4656	4882	5107	5332	226
3	5557	5782	6007	6232	6456	6681	6905	7130	7354	7578	225
4	7802	8026	8249	8473	8696	8920	9143	9366	9589	9812	223
5	290035	290257	290480	290702	290925	291147	291369	291591	291813	292034	222
6	2256	2478	2699	2920	3141	3363	3584	3804	4025	4246	221
7	4466	4687	4907	5127	5347	5567	5787	6007	6226	6446	220
8	6665	6884	7104	7323	7542	7761	7979	8198	8416	8635	219
9	8853	9071	9289	9507	9725	9943	300161	300378	300595	300813	218
200	301030	301247	301464	301681	301898	302114	302331	302547	302764	302980	217
1	3196	3412	3628	3844	4059	4275	4491	4706	4921	5136	216
2	5351	5566	5781	5996	6211	6425	6639	6854	7068	7282	215
3	7496	7710	7924	8137	8351	8564	8778	8991	9204	9417	213
4	9630	9843	310056	310268	310481	310693	310906	311118	311330	311542	212
5	311754	311966	2177	2389	2600	2812	3023	3234	3445	3656	211
6	3867	4078	4289	4499	4710	4920	5130	5340	5551	5760	210
7	5970	6180	6390	6599	6809	7018	7227	7436	7646	7854	209
8	8063	8272	8481	8689	8898	9106	9314	9522	9730	9938	208
9	320146	320354	320562	320769	320977	321184	321391	321598	321805	322012	207
210	322219	322426	322633	322839	323046	323252	323458	323665	323871	324077	206
1	4282	4488	4694	4899	5105	5310	5516	5721	5926	6131	205
2	6336	6541	6745	6950	7155	7359	7563	7767	7972	8176	204
3	8380	8583	8787	8991	9194	9398	9601	9805	330008	330211	203
4	330414	330617	330819	331022	331225	331427	331630	331832	2034	2236	202
5	2438	2640	2842	3044	3246	3447	3649	3850	4051	4253	202
6	4454	4655	4856	5057	5257	5458	5658	5859	6059	6260	201
7	6460	6660	6860	7060	7260	7459	7659	7858	8058	8257	200
8	8456	8656	8855	9054	9253	9451	9650	9849	340047	340246	199
9	340444	340642	340841	341039	341237	341435	341632	341830	2028	2225	198

No.	0	1	2	3	4	5	6	7	8	9	Diff.
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No.	0	1	2	3	4	5	6	7	8	9	Diff.
220	342423	342620	342817	343014	343212	343409	343606	343802	343999	344196	197
1	4392	4589	4785	4981	5178	5374	5570	5766	5962	6157	196
2	6353	6549	6744	6939	7135	7330	7525	7720	7915	8110	195
3	8305	8500	8694	8889	9083	9278	9472	9666	9860	350054	194
4	350248	350442	350636	350829	351023	351216	351410	351603	351796	1989	193
5	2183	2375	2568	2761	2954	3147	3339	3532	3724	3916	193
6	4108	4301	4493	4685	4876	5068	5260	5452	5643	5834	192
7	6026	6217	6408	6599	6790	6981	7172	7363	7554	7744	191
8	7935	8125	8316	8506	8696	8886	9076	9266	9456	9646	190
9	9835	360025	360215	360404	360593	360783	360972	361161	361350	361539	189
230	361728	361917	362105	362294	362482	362671	362859	363048	363236	363424	188
1	3612	3800	3988	4176	4363	4551	4739	4926	5113	5301	187
2	5488	5675	5862	6049	6236	6423	6610	6796	6983	7169	187
3	7356	7542	7729	7915	8101	8287	8473	8659	8845	9030	186
4	9216	9401	9587	9772	9958	370143	370328	370513	370698	370883	185
5	371068	371253	371437	371622	371806	1991	2175	2360	2544	2728	184
6	2912	3096	3280	3464	3647	3831	4015	4198	4382	4565	184
7	4748	4932	5115	5298	5481	5664	5846	6029	6212	6394	183
8	6577	6759	6942	7124	7306	7488	7670	7852	8034	8216	182
9	8398	8580	8761	8943	9124	9306	9487	9668	9849	380030	181
240	380211	380392	380573	380754	380934	381115	381296	381476	381656	381837	181
1	2017	2197	2377	2557	2737	2917	3097	3277	3456	3636	180
2	3815	3995	4174	4353	4533	4712	4891	5070	5249	5428	179
3	5606	5785	5964	6142	6321	6499	6677	6856	7034	7212	178
4	7390	7568	7746	7923	8101	8279	8456	8634	8811	8989	178
5	9166	9343	9520	9698	9875	390051	390228	390405	390582	390759	177
6	390935	391112	391288	391464	391641	1817	1993	2169	2345	2521	176
7	2697	2873	3048	3224	3400	3575	3751	3926	4101	4277	176
8	4452	4627	4802	4977	5152	5326	5501	5676	5850	6025	175
9	6199	6374	6548	6722	6896	7071	7245	7419	7592	7766	174
250	397940	398114	398287	398461	398634	398808	398981	399154	399328	399501	173
1	9674	9847	400020	400192	400365	400538	400711	400883	401056	401228	173
2	401401	401573	1745	1917	2089	2261	2433	2605	2777	2949	172
3	3121	3292	3464	3635	3807	3978	4149	4320	4492	4663	171
4	4834	5005	5176	5346	5517	5688	5858	6029	6199	6370	171
5	6540	6710	6881	7051	7221	7391	7561	7731	7901	8070	170
6	8240	8410	8579	8749	8918	9087	9257	9426	9595	9764	169
7	9933	410102	410271	410440	410609	410777	410946	411114	411283	411451	169
8	411620	1788	1956	2124	2293	2461	2629	2796	2964	3132	168
9	3300	3467	3635	3803	3970	4137	4305	4472	4639	4806	167
260	414973	415140	415307	415474	415641	415808	415974	416141	416308	416474	167
1	6641	6807	6973	7139	7306	7472	7638	7804	7970	8135	166
2	8301	8467	8633	8798	8964	9129	9295	9460	9625	9791	165
3	9956	420121	420286	420451	420616	420781	420945	421110	421275	421439	165
4	421604	1768	1933	2097	2261	2426	2590	2754	2918	3082	164
5	3246	3410	3574	3737	3901	4065	4228	4392	4555	4718	164
6	4882	5045	5208	5371	5534	5697	5860	6023	6186	6349	163
7	6511	6674	6836	6999	7161	7324	7486	7648	7811	7973	162
8	8135	8297	8459	8621	8783	8944	9106	9268	9429	9591	162
9	9752	9914	430075	430236	430398	430559	430720	430881	431042	431203	161
270	431364	431525	431685	431846	432007	432167	432328	432488	432649	432809	161
1	2969	3130	3290	3450	3610	3770	3930	4090	4249	4409	160
2	4569	4729	4888	5048	5207	5367	5526	5685	5844	6004	159
3	6163	6322	6481	6640	6799	6957	7116	7275	7433	7592	159
4	7751	7909	8067	8226	8384	8542	8701	8859	9017	9175	158
5	9333	9491	9648	9806	9964	440122	440279	440437	440594	440752	158
6	440909	441066	441224	441381	441538	1695	1852	2009	2166	2323	157
7	2480	2637	2793	2950	3106	3263	3419	3576	3732	3889	157
8	4045	4201	4357	4513	4669	4825	4981	5137	5293	5449	156
9	5604	5760	5915	6071	6226	6382	6537	6692	6848	7003	155

No.	0	1	2	3	4	5	6	7	8	9	Diff.
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290	447158	447313	447468	447623	447778	447933	448088	448242	448397	448552	155
1	8706	8861	9015	9170	9324	9478	9633	9787	9941	150095	154
2	450249	450403	450557	450711	450865	451018	451172	451326	451479	1633	154
3	1780	1940	2093	2247	2400	2553	2706	2859	3012	3165	153
4	3318	3471	3624	3777	3930	4082	4235	4387	4540	4692	153
5	4845	4997	5150	5302	5454	5606	5758	5910	6062	6214	152
6	6366	6518	6670	6821	6973	7125	7276	7428	7579	7731	152
7	7882	8033	8184	8336	8487	8638	8789	8940	9091	9242	151
8	9392	9543	9694	9845	9995	460146	460296	460447	460597	460748	151
9	460898	461048	461198	461348	461499	1649	1799	1948	2098	2248	150
290	462398	462548	462697	462847	462997	463146	463296	463445	463594	463744	150
1	3893	4042	4191	4340	4490	4639	4788	4936	5085	5234	149
2	5383	5532	5680	5829	5977	6126	6274	6423	6571	6719	149
3	6868	7016	7164	7312	7460	7608	7756	7904	8052	8200	148
4	8347	8495	8643	8790	8938	9085	9233	9380	9527	9675	148
5	9822	9969	470116	470263	470410	470557	470704	470851	470998	471145	147
6	471292	471438	1585	1732	1878	2025	2171	2318	2464	2610	146
7	2756	2903	3049	3195	3341	3487	3633	3779	3925	4071	146
8	4216	4362	4508	4653	4799	4944	5090	5235	5381	5526	146
9	5671	5816	5962	6107	6252	6397	6542	6687	6832	6976	145
300	477121	477266	477411	477555	477700	477844	477989	478133	478278	478422	145
1	8566	8711	8855	8999	9143	9287	9431	9575	9719	9863	144
2	480007	480151	480294	480438	480582	480725	480869	481012	481156	481299	144
3	1443	1586	1729	1872	2016	2159	2302	2445	2588	2731	143
4	2874	3016	3159	3302	3445	3587	3730	3872	4015	4157	143
5	4300	4442	4585	4727	4869	5011	5153	5295	5437	5579	142
6	5721	5863	6005	6147	6289	6430	6572	6714	6855	6997	142
7	7138	7280	7421	7563	7704	7845	7986	8127	8269	8410	141
8	8551	8692	8833	8974	9114	9255	9396	9537	9677	9818	141
9	9958	490099	490239	490380	490520	490661	490801	490941	491081	491222	140
310	491362	491502	491642	491782	491922	492062	492201	492341	492481	492621	140
1	2760	2900	3040	3179	3319	3458	3597	3737	3876	4015	139
2	4155	4294	4433	4572	4711	4850	4989	5128	5267	5406	139
3	5544	5683	5822	5960	6099	6238	6376	6515	6653	6791	139
4	6930	7068	7206	7344	7483	7621	7759	7897	8035	8173	138
5	8311	8448	8586	8724	8862	8999	9137	9275	9412	9550	138
6	9687	9824	9962	500099	500236	500374	500511	500648	500785	500922	137
7	501059	501196	501333	1470	1607	1744	1880	2017	2154	2291	137
8	2427	2564	2700	2837	2973	3109	3246	3382	3518	3655	136
9	3791	3927	4063	4199	4335	4471	4607	4743	4878	5014	136
320	505150	505286	505421	505557	505693	505828	505964	506099	506234	506370	136
1	6505	6640	6776	6911	7046	7181	7316	7451	7586	7721	135
2	7856	7991	8126	8260	8395	8530	8664	8799	8934	9068	135
3	9203	9337	9471	9606	9740	9874	510009	510143	510277	510411	134
4	510545	510679	510813	510947	511081	511215	1349	1482	1616	1750	134
5	1883	2017	2151	2284	2418	2551	2684	2818	2951	3084	133
6	3218	3351	3484	3617	3750	3883	4016	4149	4282	4415	133
7	4548	4681	4813	4946	5079	5211	5344	5476	5609	5741	133
8	5874	6006	6139	6271	6403	6535	6668	6800	6932	7064	132
9	7196	7328	7460	7592	7724	7855	7987	8119	8251	8382	132
330	518514	518646	518777	518909	519040	519171	519303	519434	519566	519697	131
1	9828	9959	520090	520221	520353	520484	520615	520745	520876	521007	131
2	521138	521269	1400	1530	1661	1792	1922	2053	2183	2314	131
3	2444	2575	2705	2835	2966	3096	3226	3356	3486	3616	130
4	3746	3876	4006	4136	4266	4396	4526	4656	4785	4915	130
5	5045	5174	5304	5434	5563	5693	5822	5951	6081	6210	129
6	6339	6469	6598	6727	6856	6985	7114	7243	7372	7501	129
7	7630	7759	7888	8016	8145	8274	8402	8531	8660	8788	129
8	8917	9045	9174	9302	9430	9559	9687	9815	9943	530072	128
9	530200	530328	530456	530584	530712	530840	530968	531096	531223	1351	128

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No.	0	1	2	3	4	5	6	7	8	9	Diff.
340	531479	531607	531734	531862	531990	532117	532245	532372	532500	532627	128
1	2754	2882	3009	3136	3264	3391	3518	3645	3772	3899	127
2	4026	4153	4280	4407	4534	4661	4787	4914	5041	5167	127
3	5294	5421	5547	5674	5800	5927	6053	6180	6306	6432	126
4	6558	6685	6811	6937	7063	7189	7315	7441	7567	7693	126
5	7819	7945	8071	8197	8322	8448	8574	8699	8825	8951	126
6	9076	9202	9327	9452	9578	9703	9829	9954	540079	540204	125
7	540329	540455	540580	540705	540830	540955	541080	541205	1330	1454	125
8	1579	1704	1829	1953	2078	2203	2327	2452	2576	2701	125
9	2825	2950	3074	3199	3323	3447	3571	3696	3820	3944	124
350	544068	544192	544316	544440	544564	544688	544812	544936	545060	545183	124
1	5307	5431	5555	5678	5802	5925	6049	6172	6296	6419	124
2	6543	6666	6789	6913	7036	7159	7282	7405	7529	7652	123
3	7775	7898	8021	8144	8267	8389	8512	8635	8758	8881	123
4	9003	9126	9249	9371	9494	9616	9739	9861	9984	550106	123
5	550228	550351	550473	550595	550717	550840	550962	551084	551206	1328	122
6	1450	1572	1694	1816	1938	2060	2181	2303	2425	2547	122
7	2668	2790	2911	3033	3155	3276	3398	3519	3640	3762	121
8	3883	4004	4126	4247	4368	4489	4610	4731	4852	4973	121
9	5094	5215	5336	5457	5578	5699	5820	5940	6061	6182	121
360	556303	556423	556544	556664	556785	556905	557026	557146	557267	557387	120
1	7507	7627	7748	7868	7988	8108	8228	8349	8469	8589	120
2	8709	8829	8948	9068	9188	9308	9428	9548	9667	9787	120
3	9907	560026	560146	560265	560385	560504	560624	560743	560863	560982	119
4	561101	1221	1340	1459	1578	1698	1817	1936	2055	2174	119
5	2293	2412	2531	2650	2769	2887	3006	3125	3244	3362	119
6	3481	3600	3718	3837	3955	4074	4192	4311	4429	4548	119
7	4666	4784	4903	5021	5139	5257	5376	5494	5612	5730	118
8	5848	5966	6084	6202	6320	6437	6555	6673	6791	6909	118
9	7026	7144	7262	7379	7497	7614	7732	7849	7967	8084	118
370	568202	568319	568436	568554	568671	568788	568905	569023	569140	569257	117
1	9374	9491	9608	9725	9842	9959	570076	570193	570309	570426	117
2	570543	570660	570776	570893	571010	571126	1243	1359	1476	1592	117
3	1709	1825	1942	2058	2174	2291	2407	2523	2639	2755	116
4	2872	2988	3104	3220	3336	3452	3568	3684	3800	3915	116
5	4031	4147	4263	4379	4494	4610	4726	4841	4957	5072	116
6	5138	5303	5419	5534	5650	5765	5880	5996	6111	6226	115
7	6341	6457	6572	6687	6802	6917	7032	7147	7262	7377	115
8	7492	7607	7722	7836	7951	8066	8181	8295	8410	8525	115
9	8639	8754	8868	8983	9097	9212	9326	9441	9555	9669	114
380	579784	579898	580012	580126	580241	580355	580469	580583	580697	580811	114
1	580925	581039	1153	1267	1381	1495	1608	1722	1836	1950	114
2	2063	2177	2291	2404	2518	2631	2745	2858	2972	3085	114
3	3199	3312	3426	3539	3652	3765	3879	3992	4105	4218	113
4	4331	4444	4557	4670	4783	4896	5009	5122	5235	5348	113
5	5461	5574	5686	5799	5912	6024	6137	6250	6362	6475	113
6	6587	6700	6812	6925	7037	7149	7262	7374	7486	7599	112
7	7711	7823	7935	8047	8160	8272	8384	8496	8608	8720	112
8	8832	8944	9056	9167	9279	9391	9503	9615	9726	9838	112
9	9950	590061	590173	590284	590396	590507	590619	590730	590842	590953	112
390	591065	591176	591287	591399	591510	591621	591732	591843	591955	592066	111
1	2177	2288	2399	2510	2621	2732	2843	2954	3064	3175	111
2	3286	3397	3508	3618	3729	3840	3950	4061	4171	4282	111
3	4393	4503	4614	4724	4834	4945	5055	5165	5276	5386	110
4	5496	5606	5717	5827	5937	6047	6157	6267	6377	6487	110
5	6597	6707	6817	6927	7037	7146	7256	7366	7476	7586	110
6	7695	7805	7914	8024	8134	8243	8353	8462	8572	8681	110
7	8791	8900	9009	9119	9228	9337	9446	9556	9665	9774	109
8	9883	9992	600101	600210	600319	600428	600537	600646	600755	600864	109
9	600973	601082	1191	1299	1408	1517	1625	1734	1843	1951	109

No.	0	1	2	3	4	5	6	7	8	9	Diff.
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No.	0	1	2	3	4	5	6	7	8	9	Dm
400	602060	602169	602277	602386	602494	602603	602711	602819	602928	603036	108
1	3144	3253	3361	3469	3577	3686	3794	3902	4010	4118	108
2	4226	4334	4442	4550	4658	4766	4874	4982	5089	5197	108
3	5305	5413	5521	5628	5736	5844	5951	6059	6166	6274	108
4	6381	6489	6596	6704	6811	6919	7026	7133	7241	7348	107
5	7455	7562	7669	7777	7884	7991	8098	8205	8312	8419	107
6	8526	8633	8740	8847	8954	9061	9167	9274	9381	9488	107
7	9594	9701	9808	9914	610021	610128	610234	610341	610447	610554	107
8	610660	610767	610873	610979	1086	1192	1298	1405	1511	1617	106
9	1723	1829	1936	2042	2148	2254	2360	2466	2572	2678	106
410	612784	612890	612996	613102	613207	613313	613419	613525	613630	613736	106
1	3842	3947	4053	4159	4264	4370	4475	4581	4686	4792	106
2	4897	5003	5108	5213	5319	5424	5529	5634	5740	5845	105
3	5950	6055	6160	6265	6370	6476	6581	6686	6790	6895	105
4	7000	7105	7210	7315	7420	7525	7629	7734	7839	7943	105
5	8048	8153	8257	8362	8466	8571	8676	8780	8884	8989	105
6	9093	9198	9302	9406	9511	9615	9719	9824	9928	620032	104
7	620136	620240	620344	620448	620552	620656	620760	620864	620968	1072	104
8	1176	1280	1384	1488	1592	1695	1799	1903	2007	2110	104
9	2214	2318	2421	2525	2628	2732	2835	2939	3042	3146	104
420	623249	623353	623456	623559	623663	623766	623869	623973	624076	624179	103
1	4282	4385	4488	4591	4695	4798	4901	5004	5107	5210	103
2	5312	5415	5518	5621	5724	5827	5929	6032	6135	6238	103
3	6340	6443	6546	6648	6751	6853	6956	7058	7161	7263	103
4	7366	7468	7571	7673	7775	7878	7980	8082	8185	8287	102
5	8389	8491	8593	8695	8797	8899	9002	9104	9206	9308	102
6	9410	9512	9613	9715	9817	9919	630021	630123	630224	630326	102
7	630428	630530	630631	630733	630835	630936	1038	1139	1241	1342	102
8	1444	1545	1647	1748	1849	1951	2052	2153	2255	2356	101
9	2457	2559	2660	2761	2862	2963	3064	3165	3266	3367	101
430	633468	633569	633670	633771	633872	633973	634074	634175	634276	634376	101
1	4477	4578	4679	4779	4880	4981	5081	5182	5283	5383	101
2	5484	5584	5685	5785	5886	5986	6087	6187	6287	6388	100
3	6488	6588	6688	6789	6889	6989	7089	7189	7290	7390	100
4	7490	7590	7690	7790	7890	7990	8090	8190	8290	8389	100
5	8489	8589	8689	8789	8888	8988	9088	9188	9287	9387	100
6	9486	9586	9686	9785	9885	9984	640084	640183	640283	640382	99
7	640481	640581	640680	640779	640879	640978	1077	1177	1276	1375	99
8	1474	1573	1672	1771	1871	1970	2069	2168	2267	2366	99
9	2465	2563	2662	2761	2860	2959	3058	3156	3255	3354	99
440	643453	643551	643650	643749	643847	643946	644044	644143	644242	644340	98
1	4439	4537	4636	4734	4832	4931	5029	5127	5226	5324	98
2	5422	5521	5619	5717	5815	5913	6011	6110	6208	6306	98
3	6404	6502	6600	6698	6796	6894	6992	7089	7187	7285	98
4	7383	7481	7579	7676	7774	7872	7969	8067	8165	8262	98
5	8360	8458	8555	8653	8750	8848	8945	9043	9140	9237	97
6	9335	9432	9530	9627	9724	9821	9919	650016	650113	650210	97
7	650308	650405	650502	650599	650696	650793	650890	0987	1084	1181	97
8	1278	1375	1472	1569	1666	1762	1859	1956	2053	2150	97
9	2246	2343	2440	2536	2633	2730	2826	2923	3019	3116	97
450	653213	653309	653405	653502	653598	653695	653791	653888	653984	654080	96
1	4177	4273	4369	4465	4562	4658	4754	4850	4946	5042	96
2	5138	5225	5331	5427	5523	5619	5715	5810	5906	6002	96
3	6098	6194	6290	6386	6482	6577	6673	6769	6864	6960	96
4	7056	7152	7247	7343	7438	7534	7629	7725	7820	7916	96
5	8011	8107	8202	8298	8393	8488	8584	8679	8774	8870	95
6	8965	9060	9155	9250	9346	9441	9536	9631	9726	9821	95
7	9916	660011	660106	660201	660296	660391	660486	660581	660676	660771	95
8	660865	0960	1055	1150	1245	1339	1434	1529	1623	1718	95
9	1813	1907	2002	2096	2191	2286	2380	2475	2569	2663	95

No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Dm

No.	0	1	2	3	4	5	6	7	8	9	Diff.
460	662758	662852	662947	663041	663135	663230	663324	663418	663512	663607	94
1	3701	3795	3889	3983	4078	4172	4266	4360	4454	4548	94
2	4642	4736	4830	4924	5018	5112	5206	5299	5393	5487	94
3	5581	5675	5769	5862	5956	6050	6143	6237	6331	6424	94
4	6518	6612	6705	6799	6892	6986	7079	7173	7266	7360	94
5	7453	7546	7640	7733	7826	7920	8013	8106	8199	8293	93
6	8386	8479	8572	8665	8759	8852	8945	9038	9131	9224	93
7	9317	9410	9503	9596	9689	9782	9875	9967	670060	670153	93
8	670246	670339	670431	670524	670617	670710	670802	670895	0968	1060	93
9	1173	1265	1358	1451	1543	1636	1728	1821	1913	2005	93
470	672068	672190	672283	672375	672467	672560	672652	672744	672836	672929	92
1	3021	3113	3205	3297	3390	3482	3574	3666	3758	3850	92
2	3942	4034	4126	4218	4310	4402	4494	4586	4677	4769	92
3	4861	4953	5045	5137	5228	5320	5412	5503	5595	5687	92
4	5778	5870	5962	6053	6145	6236	6328	6419	6511	6602	93
5	6694	6785	6876	6968	7059	7151	7242	7333	7424	7516	91
6	7607	7698	7789	7881	7972	8063	8154	8245	8336	8427	91
7	8518	8609	8700	8791	8882	8973	9064	9155	9246	9337	91
8	9428	9519	9610	9700	9791	9882	9973	680063	680154	680245	91
9	680336	680426	680517	680607	680698	680789	680879	0970	1060	1151	91
480	681241	681332	681422	681513	681603	681693	681784	681874	681964	682055	90
1	2145	2235	2326	2416	2506	2596	2686	2777	2867	2957	90
2	3047	3137	3227	3317	3407	3497	3587	3677	3767	3857	90
3	3947	4037	4127	4217	4307	4396	4486	4576	4666	4756	90
4	4845	4935	5025	5114	5204	5294	5383	5473	5563	5652	90
5	5742	5831	5921	6010	6100	6189	6279	6368	6458	6547	89
6	6636	6726	6815	6904	6994	7083	7172	7261	7351	7440	89
7	7529	7618	7707	7796	7886	7975	8064	8153	8242	8331	89
8	8420	8509	8598	8687	8776	8865	8953	9042	9131	9220	89
9	9309	9398	9486	9575	9664	9753	9841	9930	690019	690107	89
490	690196	690285	690373	690462	690550	690639	690728	690816	690905	690993	88
1	1081	1170	1258	1347	1435	1524	1612	1700	1789	1877	88
2	1965	2053	2142	2230	2318	2406	2494	2583	2671	2759	88
3	2847	2935	3023	3111	3199	3287	3375	3463	3551	3639	88
4	3727	3815	3903	3991	4078	4166	4254	4342	4430	4517	88
5	4605	4693	4781	4868	4956	5044	5131	5219	5307	5394	88
6	5482	5569	5657	5744	5832	5919	6007	6094	6182	6269	87
7	6356	6444	6531	6618	6706	6793	6880	6968	7055	7142	87
8	7229	7317	7404	7491	7578	7665	7752	7839	7926	8014	87
9	8101	8188	8275	8362	8449	8535	8622	8709	8796	8883	87
500	690970	691057	691144	691231	691317	691404	691491	691578	691664	691751	87
1	9838	9924	700011	700098	700184	700271	700358	700444	700531	700617	87
2	700704	700790	0877	0963	1050	1136	1222	1309	1395	1482	86
3	1568	1654	1741	1827	1913	1999	2086	2172	2258	2344	86
4	2431	2517	2603	2689	2775	2861	2947	3033	3119	3205	86
5	3291	3377	3463	3549	3635	3721	3807	3893	3979	4065	86
6	4151	4236	4322	4408	4494	4579	4665	4751	4837	4922	86
7	5008	5094	5179	5265	5350	5436	5522	5607	5693	5778	86
8	5864	5949	6035	6120	6206	6291	6376	6462	6547	6632	85
9	6718	6803	6888	6974	7059	7144	7229	7315	7400	7485	85
510	707570	707655	707740	707826	707911	707996	708081	708166	708251	708336	85
1	8421	8506	8591	8676	8761	8846	8931	9015	9100	9185	85
2	9270	9355	9440	9524	9609	9694	9779	9863	9948	710033	85
3	710117	710202	710287	710371	710456	710540	710625	710710	710794	0879	85
4	0963	1048	1132	1217	1301	1385	1470	1554	1639	1723	84
5	1807	1892	1976	2060	2144	2229	2313	2397	2481	2566	84
6	2650	2734	2818	2902	2986	3070	3154	3238	3323	3407	84
7	3491	3575	3659	3742	3826	3910	3994	4078	4162	4246	84
8	4330	4414	4497	4581	4665	4749	4833	4916	5000	5084	84
9	5167	5251	5335	5418	5502	5586	5669	5753	5836	5920	84

No.	0	1	2	3	4	5	6	7	8	9	Diff.
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No.	0	1	2	3	4	5	6	7	8	9	Diff
520	716003	716087	716170	716254	716337	716421	716504	716588	716671	716754	83
1	6838	6921	7004	7088	7171	7254	7338	7421	7504	7587	83
2	7671	7754	7837	7920	8003	8086	8169	8253	8336	8419	86
3	8502	8585	8668	8751	8834	8917	9000	9083	9165	9248	83
4	9331	9414	9497	9580	9663	9745	9828	9911	9994	720077	83
5	720159	720242	720325	720407	720490	720573	720655	720738	720821	720903	83
6	0986	1068	1151	1233	1316	1398	1481	1563	1646	1728	82
7	1811	1893	1975	2058	2140	2222	2305	2387	2469	2552	82
8	2634	2716	2798	2881	2963	3045	3127	3209	3291	3374	82
9	3456	3538	3620	3702	3784	3866	3948	4030	4112	4194	82
530	724276	724358	724440	724522	724604	724685	724767	724849	724931	725013	82
1	5095	5176	5258	5340	5422	5503	5585	5667	5748	5830	82
2	5912	5993	6075	6156	6238	6320	6401	6483	6564	6646	82
3	6727	6809	6890	6972	7053	7134	7216	7297	7379	7460	81
4	7541	7623	7704	7785	7866	7948	8029	8110	8191	8273	81
5	8354	8435	8516	8597	8678	8759	8841	8922	9003	9084	81
6	9165	9246	9327	9408	9489	9570	9651	9732	9813	9893	81
7	9974	730055	730136	730217	730298	730378	730459	730540	730621	730702	81
8	730782	0863	0944	1024	1105	1186	1266	1347	1428	1508	81
9	1589	1669	1750	1830	1911	1991	2072	2152	2233	2313	81
540	732394	732474	732555	732635	732715	732796	732876	732956	733037	733117	80
1	3197	3278	3358	3438	3518	3598	3679	3759	3839	3919	80
2	3999	4079	4160	4240	4320	4400	4480	4560	4640	4720	80
3	4800	4880	4960	5040	5120	5200	5279	5359	5439	5519	80
4	5599	5679	5759	5838	5918	5998	6078	6157	6237	6317	80
5	6397	6476	6556	6635	6715	6795	6874	6954	7034	7113	80
6	7193	7272	7352	7431	7511	7590	7670	7749	7829	7908	79
7	7987	8067	8146	8225	8305	8384	8463	8543	8622	8701	79
8	8781	8860	8939	9018	9097	9177	9256	9335	9414	9493	79
9	9572	9651	9731	9810	9889	9968	740047	740126	740205	740284	79
550	740363	740442	740521	740600	740678	740757	740836	740915	740994	741073	79
1	1132	1230	1309	1388	1467	1546	1624	1703	1782	1860	79
2	1939	2018	2096	2175	2254	2332	2411	2489	2568	2647	79
3	2725	2804	2882	2961	3039	3118	3196	3275	3353	3431	78
4	3510	3588	3667	3745	3823	3902	3980	4058	4136	4215	78
5	4293	4371	4449	4528	4606	4684	4762	4840	4919	4997	78
6	5075	5153	5231	5309	5387	5465	5543	5621	5699	5777	78
7	5855	5933	6011	6089	6167	6245	6323	6401	6479	6556	78
8	6634	6712	6790	6868	6945	7023	7101	7179	7256	7334	78
9	7412	7489	7567	7645	7722	7800	7878	7955	8033	8110	78
560	748188	748266	748343	748421	748498	748576	748653	748731	748808	748885	77
1	8963	9040	9118	9195	9272	9350	9427	9504	9582	9659	77
2	9736	9814	9891	9968	750045	750123	750200	750277	750354	750431	77
3	750508	750586	750663	750740	0817	0894	0971	1048	1125	1202	77
4	1279	1356	1433	1510	1587	1664	1741	1818	1895	1972	77
5	2048	2125	2202	2279	2356	2433	2509	2586	2663	2740	77
6	2816	2893	2970	3047	3123	3200	3277	3353	3430	3506	77
7	3583	3660	3736	3813	3889	3966	4042	4119	4195	4272	77
8	4348	4425	4501	4578	4654	4730	4807	4883	4960	5036	76
9	5112	5189	5265	5341	5417	5494	5570	5646	5722	5799	76
570	755875	755951	756027	756103	756180	756256	756332	756408	756484	756560	76
1	6636	6712	6788	6864	6940	7016	7092	7168	7244	7320	76
2	7396	7472	7548	7624	7700	7775	7851	7927	8003	8079	76
3	8158	8230	8306	8382	8458	8533	8609	8685	8761	8836	76
4	8912	8988	9063	9139	9214	9290	9366	9441	9517	9592	76
5	9668	9743	9819	9894	9970	760045	760121	760196	760272	760347	75
6	760422	760498	760573	760649	760724	0799	0875	0950	1025	1101	75
7	1176	1251	1326	1402	1477	1552	1627	1702	1778	1853	75
8	1928	2003	2078	2153	2228	2303	2378	2453	2529	2604	75
9	2679	2754	2829	2904	2978	3053	3128	3203	3278	3353	75

No.	0	1	2	3	4	5	6	7	8	9	Diff
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No.	0	1	2	3	4	5	6	7	8	9	Diff.
580	763428	763503	763578	763653	763727	763802	763877	763952	764027	764101	75
1	4176	4251	4326	4400	4475	4550	4624	4699	4774	4848	75
2	4923	4998	5072	5147	5221	5296	5370	5445	5520	5594	75
3	5669	5743	5818	5892	5966	6041	6115	6190	6264	6338	74
4	6413	6487	6562	6636	6710	6785	6859	6933	7007	7082	74
5	7156	7230	7304	7379	7453	7527	7601	7675	7749	7823	74
6	7898	7972	8046	8120	8194	8268	8342	8416	8490	8564	74
7	8638	8712	8786	8860	8934	9008	9082	9156	9230	9303	74
8	9377	9451	9525	9599	9673	9746	9820	9894	9968	770042	74
9	770115	770189	770263	770336	770410	770484	770557	770631	770705	0778	74
590	770852	770926	770999	771073	771146	771220	771293	771367	771440	771514	74
1	1587	1661	1734	1808	1881	1955	2028	2102	2175	2248	73
2	2322	2395	2468	2542	2615	2688	2762	2835	2908	2981	73
3	3055	3128	3201	3274	3348	3421	3494	3567	3640	3713	73
4	3786	3860	3933	4006	4079	4152	4225	4298	4371	4444	73
5	4517	4590	4663	4736	4809	4882	4955	5028	5100	5173	73
6	5246	5319	5392	5465	5538	5610	5683	5756	5829	5902	73
7	5974	6047	6120	6193	6265	6338	6411	6483	6556	6629	73
8	6701	6774	6846	6919	6992	7064	7137	7209	7282	7354	73
9	7427	7499	7572	7644	7717	7789	7862	7934	8006	8079	72
600	778151	778224	778296	778368	778441	778513	778585	778658	778730	778802	72
1	8874	8947	9019	9091	9163	9236	9308	9380	9452	9524	72
2	9596	9669	9741	9813	9885	9957	780029	780101	780173	780245	72
3	780317	780389	780461	780533	780605	780677	0749	0821	0893	0965	72
4	1037	1109	1181	1253	1324	1396	1468	1540	1612	1684	72
5	1755	1827	1899	1971	2042	2114	2186	2258	2329	2401	72
6	2473	2544	2616	2688	2759	2831	2902	2974	3046	3117	72
7	3189	3260	3332	3403	3475	3546	3618	3689	3761	3832	71
8	3904	3975	4046	4118	4189	4261	4332	4403	4475	4546	71
9	4617	4689	4760	4831	4902	4974	5045	5116	5187	5259	71
610	785330	785401	785472	785543	785615	785686	785757	785828	785899	785970	71
1	6041	6112	6183	6254	6325	6396	6467	6538	6609	6680	71
2	6751	6822	6893	6964	7035	7106	7177	7248	7319	7390	71
3	7460	7531	7602	7673	7744	7815	7885	7956	8027	8098	71
4	8168	8239	8310	8381	8451	8522	8593	8663	8734	8804	71
5	8875	8946	9016	9087	9157	9228	9299	9369	9440	9510	71
6	9581	9651	9722	9792	9863	9933	790004	790074	790144	790215	70
7	790285	790356	790426	790496	790567	790637	0707	0778	0848	0918	70
8	0988	1059	1129	1199	1269	1340	1410	1480	1550	1620	70
9	1691	1761	1831	1901	1971	2041	2111	2181	2252	2322	70
620	792392	792462	792532	792602	792672	792742	792812	792882	792952	793022	70
1	3092	3162	3231	3301	3371	3441	3511	3581	3651	3721	70
2	3790	3860	3930	4000	4070	4139	4209	4279	4349	4418	70
3	4488	4558	4627	4697	4767	4836	4906	4976	5045	5115	70
4	5185	5254	5324	5393	5463	5532	5602	5672	5741	5811	70
5	5880	5949	6019	6088	6158	6227	6297	6366	6436	6505	69
6	6574	6644	6713	6782	6852	6921	6990	7060	7129	7198	69
7	7268	7337	7406	7475	7545	7614	7683	7752	7821	7890	69
8	7960	8029	8098	8167	8236	8305	8374	8443	8513	8582	69
9	8651	8720	8789	8858	8927	8996	9065	9134	9203	9272	69
630	799341	799409	799478	799547	799616	799685	799754	799823	799892	799961	69
1	800029	800098	800167	800236	800305	800373	800442	800511	800580	800648	69
2	0717	0786	0854	0923	0992	1061	1129	1198	1266	1335	69
3	1404	1472	1541	1609	1678	1747	1815	1884	1952	2021	69
4	2089	2158	2226	2295	2363	2432	2500	2568	2637	2705	68
5	2774	2842	2910	2979	3047	3116	3184	3252	3321	3389	68
6	3457	3525	3594	3662	3730	3798	3867	3935	4003	4071	68
7	4139	4208	4276	4344	4412	4480	4548	4616	4685	4753	68
8	4821	4889	4957	5025	5093	5161	5229	5297	5365	5433	68
9	5501	5569	5637	5705	5773	5841	5908	5976	6044	6112	68
No.	0	1	2	3	4	5	6	7	8	9	Diff.

No.	0	1	2	3	4	5	6	7	8	9	Diff
640	806180	806248	806316	806384	806451	806519	806587	806655	806723	806790	68
1	6858	6926	6994	7061	7129	7197	7264	7332	7400	7467	68
2	7535	7603	7670	7738	7806	7873	7941	8008	8076	8143	68
3	8211	8279	8346	8414	8481	8549	8616	8684	8751	8818	67
4	8886	8953	9021	9088	9156	9223	9290	9358	9425	9492	67
5	9560	9627	9694	9762	9829	9896	9964	810031	810098	810165	67
6	810233	810300	810367	810434	810501	810569	810636	0703	0770	0837	67
7	0904	0971	1039	1106	1173	1240	1307	1374	1441	1508	67
8	1575	1642	1709	1776	1843	1910	1977	2044	2111	2178	67
9	2245	2312	2379	2445	2512	2579	2646	2713	2780	2847	67
650	812913	812980	813047	813114	813181	813247	813314	813381	813448	813514	67
1	3581	3648	3714	3781	3848	3914	3981	4048	4114	4181	67
2	4248	4314	4381	4447	4514	4581	4647	4714	4780	4847	67
3	4913	4980	5046	5113	5179	5246	5312	5378	5445	5511	66
4	5578	5644	5711	5777	5843	5910	5976	6042	6109	6175	66
5	6241	6308	6374	6440	6506	6573	6639	6705	6771	6838	66
6	6904	6970	7036	7102	7169	7235	7301	7367	7433	7499	66
7	7565	7631	7698	7764	7830	7896	7962	8028	8094	8160	66
8	8226	8292	8358	8424	8490	8556	8622	8688	8754	8820	66
9	8885	8951	9017	9083	9149	9215	9281	9346	9412	9478	66
660	819544	819610	819676	819741	819807	819873	819939	820004	820070	820136	66
1	820201	820267	820333	820399	820464	820530	820595	0661	0727	0792	66
2	0858	0924	0989	1055	1120	1186	1251	1317	1382	1448	66
3	1514	1579	1645	1710	1775	1841	1906	1972	2037	2103	65
4	2168	2233	2299	2364	2430	2495	2560	2626	2691	2756	65
5	2822	2887	2952	3018	3083	3148	3213	3279	3344	3409	65
6	3474	3539	3605	3670	3735	3800	3865	3930	3996	4061	65
7	4126	4191	4256	4321	4386	4451	4516	4581	4646	4711	65
8	4776	4841	4906	4971	5036	5101	5166	5231	5296	5361	65
9	5426	5491	5556	5621	5686	5751	5815	5880	5945	6010	65
670	826075	826140	826204	826269	826334	826399	826464	826528	826593	826658	65
1	6723	6787	6852	6917	6981	7046	7111	7175	7240	7305	65
2	7369	7434	7499	7563	7628	7692	7757	7821	7886	7951	65
3	8015	8080	8144	8209	8273	8338	8402	8467	8531	8595	64
4	8660	8724	8789	8853	8918	8982	9046	9111	9175	9239	64
5	9304	9368	9432	9497	9561	9625	9690	9754	9818	9882	64
6	9947	830011	830075	830139	830204	830268	830332	830396	830460	830525	64
7	830589	0653	0717	0781	0845	0909	0973	1037	1102	1166	64
8	1230	1294	1358	1422	1486	1550	1614	1678	1742	1806	64
9	1870	1934	1998	2062	2126	2189	2253	2317	2381	2445	64
680	832509	832573	832637	832700	832764	832828	832892	832956	833020	833083	64
1	3147	3211	3275	3338	3402	3466	3530	3593	3657	3721	64
2	3784	3848	3912	3975	4039	4103	4166	4230	4294	4357	64
3	4421	4484	4548	4611	4675	4739	4802	4866	4929	4993	64
4	5056	5120	5183	5247	5310	5373	5437	5500	5564	5627	63
5	5691	5754	5817	5881	5944	6007	6071	6134	6197	6261	63
6	6324	6387	6451	6514	6577	6641	6704	6767	6830	6894	63
7	6957	7020	7083	7146	7210	7273	7336	7399	7462	7525	63
8	7588	7652	7715	7778	7841	7904	7967	8030	8093	8156	63
9	8219	8282	8345	8408	8471	8534	8597	8660	8723	8786	63
690	838849	838912	838975	839038	839101	839164	839227	839289	839352	839415	63
1	9478	9541	9604	9667	9729	9792	9855	9918	9981	840043	63
2	840116	840169	840232	840294	840357	840420	840482	840545	840608	0671	63
3	0733	0796	0859	0921	0984	1046	1109	1172	1234	1297	63
4	1359	1422	1485	1547	1610	1672	1735	1797	1860	1922	63
5	1985	2047	2110	2172	2235	2297	2360	2422	2484	2547	62
6	2609	2672	2734	2796	2859	2921	2983	3046	3108	3170	62
7	3233	3295	3357	3420	3482	3544	3606	3669	3731	3793	62
8	3855	3918	3980	4042	4104	4166	4229	4291	4353	4415	62
9	4477	4539	4601	4664	4726	4788	4850	4912	4974	5036	62

No.	0	1	2	3	4	5	6	7	8	9	Diff
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No.	0	1	2	3	4	5	6	7	8	9	Diff.
700	845098	845160	845222	845284	845346	845408	845470	845532	845594	845656	62
1	5718	5780	5842	5904	5966	6028	6090	6151	6213	6275	62
2	6337	6399	6461	6523	6585	6646	6708	6770	6832	6894	62
3	6955	7017	7079	7141	7202	7264	7326	7388	7449	7511	62
4	7573	7634	7696	7758	7819	7881	7943	8004	8066	8128	62
5	8189	8251	8312	8374	8435	8497	8559	8620	8682	8743	62
6	8805	8866	8928	8989	9051	9112	9174	9235	9297	9358	61
7	9419	9481	9542	9604	9665	9726	9788	9849	9911	9972	61
8	850033	850095	850156	850217	850279	850340	850401	850462	850524	850585	61
9	0646	0707	0769	0830	0891	0952	1014	1075	1136	1197	61
710	851258	851320	851381	851442	851503	851564	851625	851686	851747	851809	61
1	1870	1931	1992	2053	2114	2175	2236	2297	2358	2419	61
2	2480	2541	2602	2663	2724	2785	2846	2907	2968	3029	61
3	3090	3150	3211	3272	3333	3394	3455	3516	3577	3637	61
4	3698	3759	3820	3881	3941	4002	4063	4124	4185	4245	61
5	4306	4367	4428	4488	4549	4610	4670	4731	4792	4852	61
6	4913	4974	5034	5095	5156	5216	5277	5337	5398	5459	61
7	5519	5580	5640	5701	5761	5822	5882	5943	6003	6064	61
8	6124	6185	6245	6306	6366	6427	6487	6548	6608	6668	60
9	6729	6789	6850	6910	6970	7031	7091	7152	7212	7272	60
720	857332	857393	857453	857513	857574	857634	857694	857755	857815	857875	60
1	7935	7995	8056	8116	8176	8236	8297	8357	8417	8477	60
2	8537	8597	8657	8718	8778	8838	8898	8958	9018	9078	60
3	9138	9198	9258	9318	9379	9439	9499	9559	9619	9679	60
4	9739	9799	9859	9918	9978	860038	860098	860158	860218	860278	60
5	860338	860398	860458	860518	860578	0637	0697	0757	0817	0877	60
6	0937	0996	1056	1116	1176	1236	1295	1355	1415	1475	60
7	1534	1594	1654	1714	1773	1833	1893	1952	2012	2072	60
8	2131	2191	2251	2310	2370	2430	2489	2549	2608	2668	60
9	2728	2787	2847	2906	2966	3025	3085	3144	3204	3263	60
730	863323	863382	863442	863501	863561	863620	863680	863739	863799	863858	59
1	3917	3977	4036	4096	4155	4214	4274	4333	4392	4452	59
2	4511	4570	4630	4689	4748	4808	4867	4926	4985	5045	59
3	5104	5163	5222	5282	5341	5400	5459	5519	5578	5637	59
4	5696	5755	5814	5874	5933	5992	6051	6110	6169	6228	59
5	6287	6346	6405	6465	6524	6583	6642	6701	6760	6819	59
6	6878	6937	6996	7055	7114	7173	7232	7291	7350	7409	59
7	7467	7526	7585	7644	7703	7762	7821	7880	7939	7998	59
8	8056	8115	8174	8233	8292	8350	8409	8468	8527	8586	59
9	8644	8703	8762	8821	8879	8938	8997	9056	9114	9173	59
740	869232	869290	869349	869408	869466	869525	869584	869642	869701	869760	59
1	9818	9877	9935	9994	870053	870111	870170	870228	870287	870345	59
2	870404	870462	870521	870579	0638	0696	0755	0813	0872	0930	58
3	0989	1047	1106	1164	1223	1281	1339	1398	1456	1515	58
4	1573	1631	1690	1748	1806	1865	1923	1981	2040	2098	58
5	2156	2215	2273	2331	2389	2448	2506	2564	2622	2681	58
6	2739	2797	2855	2913	2972	3030	3088	3146	3204	3262	58
7	3321	3379	3437	3495	3553	3611	3669	3727	3785	3844	58
8	3902	3960	4018	4076	4134	4192	4250	4308	4366	4424	58
9	4482	4540	4598	4656	4714	4772	4830	4888	4945	5003	58
750	875061	875119	875177	875235	875293	875351	875409	875466	875524	875582	58
1	5640	5698	5756	5813	5871	5929	5987	6045	6102	6160	58
2	6218	6276	6333	6391	6449	6507	6564	6622	6680	6737	58
3	6795	6853	6910	6968	7026	7083	7141	7199	7256	7314	58
4	7371	7429	7487	7544	7602	7659	7717	7774	7832	7889	58
5	7947	8004	8062	8119	8177	8234	8292	8349	8407	8464	57
6	8522	8579	8637	8694	8752	8809	8866	8924	8981	9039	57
7	9096	9153	9211	9268	9325	9383	9440	9497	9555	9612	57
8	9669	9726	9784	9841	9898	9956	880013	880070	880127	880185	57
9	880242	880299	880356	880413	880471	880528	0585	0642	0699	0756	57

No.	0	1	2	3	4	5	6	7	8	9	Diff.
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No.	0	1	2	3	4	5	6	7	8	9	Diff.
760	880814	880871	880928	880985	881042	881099	881156	881213	881271	881328	57
1	1385	1442	1499	1556	1613	1670	1727	1784	1841	1898	57
2	1955	2012	2069	2126	2183	2240	2297	2354	2411	2468	57
3	2525	2581	2638	2695	2752	2809	2866	2923	2980	3037	57
4	3093	3150	3207	3264	3321	3377	3434	3491	3548	3605	57
5	3661	3718	3775	3832	3888	3945	4002	4059	4115	4172	57
6	4229	4285	4342	4399	4455	4512	4569	4625	4682	4739	57
7	4795	4852	4909	4965	5022	5078	5135	5192	5248	5305	57
8	5361	5418	5474	5531	5587	5644	5700	5757	5813	5870	57
9	5926	5983	6039	6096	6152	6209	6265	6321	6378	6434	56
770	886491	886547	886604	886660	886716	886773	886829	886885	886942	886998	56
1	7054	7111	7167	7223	7280	7336	7392	7449	7505	7561	56
2	7617	7674	7730	7786	7842	7898	7955	8011	8067	8123	56
3	8179	8236	8292	8348	8404	8460	8516	8573	8629	8685	56
4	8741	8797	8853	8909	8965	9021	9077	9134	9190	9246	56
5	9302	9358	9414	9470	9526	9582	9638	9694	9750	9806	56
6	9862	9918	9974	890030	890086	890141	890197	890253	890309	890365	56
7	890421	890477	890533	0589	0645	0700	0756	0812	0868	0924	56
8	0980	1035	1091	1147	1203	1259	1314	1370	1426	1482	56
9	1537	1593	1649	1705	1760	1816	1872	1928	1983	2039	56
780	892005	892150	892206	892262	892317	892373	892429	892484	892540	892595	56
1	2651	2707	2762	2818	2873	2929	2985	3040	3096	3151	56
2	3207	3262	3318	3373	3429	3484	3540	3595	3651	3706	56
3	3762	3817	3873	3928	3984	4039	4094	4150	4205	4261	55
4	4316	4371	4427	4482	4538	4593	4648	4704	4759	4814	55
5	4870	4925	4980	5036	5091	5146	5201	5257	5312	5367	55
6	5423	5478	5533	5588	5644	5699	5754	5809	5864	5920	55
7	5975	6030	6085	6140	6195	6251	6306	6361	6416	6471	55
8	6526	6581	6636	6692	6747	6802	6857	6912	6967	7022	55
9	7077	7132	7187	7242	7297	7352	7407	7462	7517	7572	55
790	897627	897682	897737	897792	897847	897902	897957	898012	898067	898122	55
1	8176	8231	8286	8341	8396	8451	8506	8561	8615	8670	55
2	8725	8780	8835	8890	8944	8999	9054	9109	9164	9218	55
3	9273	9328	9383	9437	9492	9547	9602	9656	9711	9766	55
4	9821	9875	9930	9985	900039	900094	900149	900203	900258	900312	55
5	900367	900422	900476	900531	0586	0640	0695	0749	0804	0859	55
6	0913	0968	1022	1077	1131	1186	1240	1295	1349	1404	55
7	1458	1513	1567	1622	1676	1731	1785	1840	1894	1948	54
8	2003	2057	2112	2166	2221	2275	2329	2384	2438	2492	54
9	2547	2601	2655	2710	2764	2818	2873	2927	2981	3036	54
800	903090	903144	903199	903253	903307	903361	903416	903470	903524	903578	54
1	3633	3687	3741	3795	3849	3904	3958	4012	4066	4120	54
2	4174	4229	4283	4337	4391	4445	4499	4553	4607	4661	54
3	4716	4770	4824	4878	4932	4986	5040	5094	5148	5202	54
4	5256	5310	5364	5418	5472	5526	5580	5634	5688	5742	54
5	5796	5850	5904	5958	6012	6066	6119	6173	6227	6281	54
6	6335	6389	6443	6497	6551	6604	6658	6712	6766	6820	54
7	6874	6927	6981	7035	7089	7143	7196	7250	7304	7358	54
8	7411	7465	7519	7573	7626	7680	7734	7787	7841	7895	54
9	7949	8002	8056	8110	8163	8217	8270	8324	8378	8431	54
810	908485	908539	908592	908646	908699	908753	908807	908860	908914	908967	54
1	9021	9074	9128	9181	9235	9289	9342	9396	9449	9503	54
2	9556	9610	9663	9716	9770	9823	9877	9930	9984	910037	53
3	910091	910144	910197	910251	910304	910358	910411	910464	910518	910571	53
4	0624	0678	0731	0784	0838	0891	0944	0998	1051	1104	53
5	1158	1211	1264	1317	1371	1424	1477	1530	1584	1637	53
6	1690	1743	1797	1850	1903	1956	2009	2063	2116	2169	53
7	2222	2275	2328	2381	2435	2488	2541	2594	2647	2700	53
8	2753	2806	2859	2913	2966	3019	3072	3125	3178	3231	53
9	3284	3337	3390	3443	3496	3549	3602	3655	3708	3761	53

No.	0	1	2	3	4	5	6	7	8	9	Diff.
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No.	0	1	2	3	4	5	6	7	8	9	Diff.
820	913814	913867	913920	913973	914026	914079	914132	914184	914237	914290	53
1	4343	4396	4449	4502	4555	4608	4660	4713	4766	4819	53
2	4872	4925	4977	5030	5083	5136	5189	5241	5294	5347	53
3	5400	5453	5505	5558	5611	5664	5716	5769	5822	5875	53
4	5927	5980	6033	6085	6138	6191	6243	6296	6349	6401	53
5	6454	6507	6559	6612	6664	6717	6770	6822	6875	6927	53
6	6980	7033	7085	7138	7190	7243	7295	7348	7400	7453	53
7	7506	7558	7611	7663	7716	7768	7820	7873	7925	7978	52
8	8030	8083	8135	8188	8240	8293	8345	8397	8450	8502	52
9	8555	8607	8659	8712	8764	8816	8869	8921	8973	9026	52
830	919078	919130	919183	919235	919287	919340	919392	919444	919496	919549	52
1	9601	9653	9706	9758	9810	9862	9914	9967	920019	920071	52
2	920123	920176	920228	920280	920332	920384	920436	920489	0541	0593	52
3	0645	0697	0749	0801	0853	0906	0958	1010	1062	1114	52
4	1166	1218	1270	1322	1374	1426	1478	1530	1582	1634	52
5	1686	1738	1790	1842	1894	1946	1998	2050	2102	2154	52
6	2206	2258	2310	2362	2414	2466	2518	2570	2622	2674	52
7	2725	2777	2829	2881	2933	2985	3037	3089	3140	3192	52
8	3244	3296	3348	3399	3451	3503	3555	3607	3658	3710	52
9	3762	3814	3865	3917	3969	4021	4072	4124	4176	4228	52
840	924279	924331	924383	924434	924486	924538	924589	924641	924693	924744	52
1	4796	4848	4899	4951	5003	5054	5106	5157	5209	5261	52
2	5312	5364	5415	5467	5518	5570	5621	5673	5725	5776	52
3	5828	5879	5931	5982	6034	6085	6137	6188	6240	6291	51
4	6342	6394	6445	6497	6548	6600	6651	6702	6754	6805	51
5	6857	6908	6959	7011	7062	7114	7165	7216	7268	7319	51
6	7370	7422	7473	7524	7576	7627	7678	7730	7781	7832	51
7	7883	7935	7986	8037	8088	8140	8191	8242	8293	8345	51
8	8396	8447	8498	8549	8601	8652	8703	8754	8805	8857	51
9	8908	8959	9010	9061	9112	9163	9215	9266	9317	9368	51
850	929419	929470	929521	929572	929623	929674	929725	929776	929827	929879	51
1	9930	9981	930032	930083	930134	930185	930236	930287	930338	930389	51
2	930440	930491	0542	0592	0643	0694	0745	0796	0847	0898	51
3	0949	1000	1051	1102	1153	1204	1254	1305	1356	1407	51
4	1458	1509	1560	1610	1661	1712	1763	1814	1865	1915	51
5	1966	2017	2068	2118	2169	2220	2271	2322	2372	2423	51
6	2474	2524	2575	2626	2677	2727	2778	2829	2879	2930	51
7	2981	3031	3082	3133	3183	3234	3285	3335	3386	3437	51
8	3487	3538	3589	3639	3690	3740	3791	3841	3892	3943	51
9	3993	4044	4094	4145	4195	4246	4296	4347	4397	4448	51
860	934498	934549	934599	934650	934700	934751	934801	934852	934902	934953	50
1	5003	5054	5104	5154	5205	5255	5306	5356	5406	5457	50
2	5507	5558	5608	5658	5709	5759	5809	5860	5910	5960	50
3	6011	6061	6111	6162	6212	6262	6313	6363	6413	6463	50
4	6514	6564	6614	6665	6715	6765	6815	6865	6916	6966	50
5	7016	7066	7117	7167	7217	7267	7317	7367	7418	7468	50
6	7518	7568	7618	7668	7718	7769	7819	7869	7919	7969	50
7	8019	8069	8119	8169	8219	8269	8320	8370	8420	8470	50
8	8520	8570	8620	8670	8720	8770	8820	8870	8920	8970	50
9	9020	9070	9120	9170	9220	9270	9320	9369	9419	9469	50
870	939519	939569	939619	939669	939719	939769	939819	939869	939918	939968	50
1	940018	940068	940118	940168	940218	940267	940317	940367	940417	940467	50
2	0516	0566	0616	0666	0716	0765	0815	0865	0915	0964	50
3	1014	1064	1114	1163	1213	1263	1313	1362	1412	1462	50
4	1511	1561	1611	1660	1710	1760	1809	1859	1909	1958	50
5	2008	2058	2107	2157	2207	2256	2306	2355	2405	2455	50
6	2504	2554	2603	2653	2702	2752	2801	2851	2901	2950	50
7	3000	3049	3099	3148	3198	3247	3297	3346	3396	3445	49
8	3495	3544	3593	3643	3692	3742	3791	3841	3890	3939	49
9	3989	4038	4088	4137	4186	4236	4285	4335	4384	4433	49
No.	0	1	2	3	4	5	6	7	8	9	Diff.

No.	0	1	2	3	4	5	6	7	8	9	Difference
880	944483	944532	944581	944631	944680	944729	944779	944828	944877	944927	49
1	4976	5025	5074	5124	5173	5222	5272	5321	5370	5419	49
2	5469	5518	5567	5616	5665	5715	5764	5813	5862	5912	49
3	5961	6010	6059	6108	6157	6207	6256	6305	6354	6403	49
4	6452	6501	6551	6600	6649	6698	6747	6796	6845	6894	49
5	6943	6992	7041	7090	7140	7189	7238	7287	7336	7385	49
6	7434	7483	7532	7581	7630	7679	7728	7777	7826	7875	49
7	7924	7973	8022	8070	8119	8168	8217	8266	8315	8364	49
8	8413	8462	8511	8560	8609	8657	8706	8755	8804	8853	49
9	8902	8951	8999	9048	9097	9146	9195	9244	9292	9341	49
890	949390	949439	949488	949536	949585	949634	949683	949731	949780	949829	49
1	9878	9926	9975	950024	950073	950121	950170	950219	950267	950316	49
2	950365	950414	950462	0511	0560	0608	0657	0706	0754	0803	49
3	0851	0900	0949	0997	1046	1095	1143	1192	1240	1289	49
4	1338	1386	1435	1483	1532	1580	1629	1677	1726	1775	49
5	1823	1872	1920	1969	2017	2066	2114	2163	2211	2260	48
6	2308	2356	2405	2453	2502	2550	2599	2647	2696	2744	48
7	2792	2841	2889	2938	2986	3034	3083	3131	3180	3228	48
8	3276	3325	3373	3421	3470	3518	3566	3615	3663	3711	48
9	3700	3808	3856	3905	3953	4001	4049	4098	4146	4194	48
900	954243	954291	954339	954387	954435	954484	954532	954580	954628	954677	48
1	4725	4773	4821	4869	4918	4966	5014	5062	5110	5158	48
2	5207	5255	5303	5351	5399	5447	5495	5543	5592	5640	48
3	5688	5736	5784	5832	5880	5928	5976	6024	6072	6120	48
4	6168	6216	6265	6313	6361	6409	6457	6505	6553	6601	48
5	6649	6697	6745	6793	6840	6888	6936	6984	7032	7080	48
6	7128	7176	7224	7272	7320	7368	7416	7464	7512	7559	48
7	7607	7655	7703	7751	7799	7847	7894	7942	7990	8038	48
8	8086	8134	8181	8229	8277	8325	8373	8421	8468	8516	48
9	8564	8612	8659	8707	8755	8803	8850	8898	8946	8994	48
910	959041	959089	959137	959185	959232	959280	959328	959375	959423	959471	48
1	9518	9566	9614	9661	9709	9757	9804	9852	9900	9947	48
2	9995	960042	960090	960138	960185	960233	960281	960328	960376	960423	48
3	960471	0518	0566	0613	0661	0709	0756	0804	0851	0899	48
4	0946	0994	1041	1089	1136	1184	1231	1279	1326	1374	48
5	1421	1469	1516	1563	1611	1658	1706	1753	1801	1848	47
6	1895	1943	1990	2038	2085	2132	2180	2227	2275	2322	47
7	2369	2417	2464	2511	2559	2606	2653	2701	2748	2795	47
8	2843	2890	2937	2985	3032	3079	3126	3174	3221	3268	47
9	3316	3363	3410	3457	3504	3552	3599	3646	3693	3741	47
920	963788	963835	963882	963929	963977	964024	964071	964118	964165	964212	47
1	4260	4307	4354	4401	4448	4495	4542	4589	4637	4684	47
2	4731	4778	4825	4872	4919	4966	5013	5061	5108	5155	47
3	5202	5249	5296	5343	5390	5437	5484	5531	5578	5625	47
4	5672	5719	5766	5813	5860	5907	5954	6001	6048	6095	47
5	6142	6189	6236	6283	6329	6376	6423	6470	6517	6564	47
6	6611	6658	6705	6752	6799	6845	6892	6939	6986	7033	47
7	7080	7127	7173	7220	7267	7314	7361	7408	7454	7501	47
8	7548	7595	7642	7688	7735	7782	7829	7875	7922	7969	47
9	8016	8062	8109	8156	8203	8249	8296	8343	8390	8436	47
930	968483	968530	968576	968623	968670	968716	968763	968810	968856	968903	47
1	8950	8996	9043	9090	9136	9183	9229	9276	9323	9369	47
2	9416	9463	9509	9556	9602	9649	9695	9742	9789	9835	47
3	9882	9928	9975	970021	970068	970114	970161	970207	970254	970300	47
4	970347	970393	970440	0486	0533	0579	0626	0672	0719	0765	46
5	0812	0858	0904	0951	0997	1044	1090	1137	1183	1229	46
6	1276	1322	1369	1415	1461	1508	1554	1601	1647	1693	46
7	1740	1786	1832	1879	1925	1971	2018	2064	2110	2157	46
8	2203	2249	2295	2342	2388	2434	2481	2527	2573	2619	46
9	2666	2712	2758	2804	2851	2897	2943	2989	3035	3082	46

No.	0	1	2	3	4	5	6	7	8	9	Difference
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No.	0	1	2	3	4	5	6	7	8	9	Diff
940	973128	973174	973220	973266	973313	973359	973405	973451	973497	973543	46
1	3590	3636	3682	3728	3774	3820	3866	3913	3959	4005	46
2	4051	4097	4143	4189	4235	4281	4327	4374	4420	4466	46
3	4512	4558	4604	4650	4696	4742	4788	4834	4880	4926	46
4	4972	5018	5064	5110	5156	5202	5248	5294	5340	5386	46
5	5432	5478	5524	5570	5616	5662	5707	5753	5799	5845	46
6	5891	5937	5983	6029	6075	6121	6167	6212	6258	6304	46
7	6350	6396	6442	6488	6533	6579	6625	6671	6717	6763	46
8	6808	6854	6900	6946	6992	7037	7083	7129	7175	7220	46
9	7266	7312	7358	7403	7449	7495	7541	7586	7632	7678	46
950	977724	977769	977815	977861	977906	977952	977998	978043	978089	978135	46
1	8181	8226	8272	8317	8363	8409	8454	8500	8546	8591	46
2	8637	8683	8728	8774	8819	8865	8911	8956	9002	9047	46
3	9093	9138	9184	9230	9275	9321	9366	9412	9457	9503	46
4	9548	9594	9639	9685	9730	9776	9821	9867	9912	9958	46
5	980003	980049	980094	980140	980185	980231	980276	980322	980367	980412	45
6	0458	0503	0549	0594	0640	0685	0730	0776	0821	0867	45
7	0912	0957	1003	1048	1093	1139	1184	1229	1275	1320	45
8	1366	1411	1456	1501	1547	1592	1637	1683	1728	1773	45
9	1819	1864	1909	1954	2000	2045	2090	2135	2181	2226	45
960	982271	982316	982362	982407	982452	982497	982543	982588	982633	982678	45
1	2723	2769	2814	2859	2904	2949	2994	3040	3085	3130	45
2	3175	3220	3265	3310	3356	3401	3446	3491	3536	3581	45
3	3626	3671	3716	3762	3807	3852	3897	3942	3987	4032	45
4	4077	4122	4167	4212	4257	4302	4347	4392	4437	4482	45
5	4527	4572	4617	4662	4707	4752	4797	4842	4887	4932	45
6	4977	5022	5067	5112	5157	5202	5247	5292	5337	5382	45
7	5426	5471	5516	5561	5606	5651	5696	5741	5786	5830	45
8	5875	5920	5965	6010	6055	6100	6144	6189	6234	6279	45
9	6324	6369	6413	6458	6503	6548	6593	6637	6682	6727	45
970	986772	986817	986861	986906	986951	986996	987040	987085	987130	987175	45
1	7219	7264	7309	7353	7398	7443	7488	7532	7577	7622	45
2	7666	7711	7756	7800	7845	7890	7934	7979	8024	8068	45
3	8113	8157	8202	8247	8291	8336	8381	8425	8470	8514	45
4	8559	8604	8648	8693	8737	8782	8826	8871	8916	8960	45
5	9005	9049	9094	9138	9183	9227	9272	9316	9361	9405	45
6	9450	9494	9539	9583	9628	9672	9717	9761	9806	9850	44
7	9895	9939	9983	990028	990072	990117	990161	990206	990250	990294	44
8	990339	990383	990428	0472	0516	0561	0605	0650	0694	0738	44
9	0783	0827	0871	0916	0960	1004	1049	1093	1137	1182	44
980	991226	991270	991315	991359	991403	991448	991492	991536	991580	991625	44
1	1669	1713	1758	1802	1846	1890	1935	1979	2023	2067	44
2	2111	2156	2200	2244	2288	2333	2377	2421	2465	2509	44
3	2554	2598	2642	2686	2730	2774	2819	2863	2907	2951	44
4	2995	3039	3083	3127	3172	3216	3260	3304	3348	3392	44
5	3436	3480	3524	3568	3613	3657	3701	3745	3789	3833	44
6	3877	3921	3965	4009	4053	4097	4141	4185	4229	4273	44
7	4317	4361	4405	4449	4493	4537	4581	4625	4669	4713	44
8	4757	4801	4845	4889	4933	4977	5021	5065	5108	5152	44
9	5196	5240	5284	5328	5372	5416	5460	5504	5547	5591	44
990	995635	995679	995723	995767	995811	995854	995898	995942	995986	996030	44
1	6074	6117	6161	6205	6249	6293	6337	6380	6424	6468	44
2	6512	6555	6599	6643	6687	6731	6774	6818	6862	6906	44
3	6949	6993	7037	7080	7124	7168	7212	7255	7299	7343	44
4	7386	7430	7474	7517	7561	7605	7648	7692	7736	7779	44
5	7823	7867	7910	7954	7998	8041	8085	8129	8172	8216	44
6	8259	8303	8347	8390	8434	8477	8521	8564	8608	8652	44
7	8695	8739	8782	8826	8869	8913	8956	9000	9043	9087	44
8	9131	9174	9218	9261	9305	9348	9392	9435	9479	9522	44
9	9565	9609	9652	9696	9739	9783	9826	9870	9913	9957	43

No.	0	1	2	3	4	5	6	7	8	9	Diff
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TABLE XXVIII.

LOGARITHMIC SINES, COSINES, TANGENTS, AND COTANGENTS.

N. B. — **THE** minutes in the left-hand column of each page, increasing downwards, belong to the degrees at the top; and those increasing upwards, in the right-hand column, belong to the degrees below.

In using the differences for one second, in columns D, the two right-hand figures should be marked off as decimals. Thus the difference for log. sin. $1^{\circ} 12' 5''$ would be $99.82 \times 5 = 499.1$, additive to the mantissa .321027 treated as an integer, and the difference for log. cos. $8^{\circ} 30' 50''$ would be $0.30 \times 50 = 16.0$ subtractive from the mantissa .995203 treated as an integer.

The differences in columns D range opposite the upper one of the two functions to which they respectively apply.

The first column D refers to Sines, the second to Cosines, the third to both Tangents and Cotangents.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	Inf. Neg.		10.00000		0.00000		Infinit.	60
1	6.463726	501717	000000	00	6.463726	501717	13.536274	59
2	764756	293485	000000	00	764756	293485	235244	58
3	940847	206231	000000	00	940847	206231	059153	57
4	7.065786	161517	000000	00	7.065786	161517	12.934214	56
5	162696	131968	000000	00	162696	131968	837304	55
6	241877	111578	9.999999	01	241878	111578	758122	54
7	308824	96653	999999	01	308825	96653	691175	53
8	366816	85254	999999	01	366817	85254	633183	52
9	417968	76263	999999	01	417970	76263	582030	51
10	463725	68968	999998	01	463727	68968	536273	50
11	7.505118	62981	9.999998	01	7.505120	62981	12.494880	49
12	542906	57996	999997	01	542909	57938	457091	48
13	577668	53641	999997	01	577672	53642	422328	47
14	609863	49938	999996	01	609857	49939	390143	46
15	639816	46714	999996	01	639820	46715	360180	45
16	667845	43881	999995	01	667849	43882	332151	44
17	694173	41372	999995	01	694179	41373	305821	43
18	718997	39135	999994	01	719003	39136	280997	42
19	742477	37127	999993	01	742484	37128	257516	41
20	764754	35315	999993	01	764761	35317	235239	40
21	7.785943	33672	9.999992	01	7.785951	33673	12.214049	39
22	806146	32175	999991	01	806155	32176	193845	38
23	825451	30805	999990	01	825460	30806	174540	37
24	843934	29547	999989	02	843944	29549	156056	36
25	861662	28388	999988	02	861674	28390	138326	35
26	878695	27317	999988	02	878708	27318	121292	34
27	895085	26323	999987	02	895099	26325	104901	33
28	910879	25399	999986	02	910894	25401	089106	32
29	926119	24538	999985	02	926134	24540	073866	31
30	940842	23733	999983	02	940858	23735	059142	30
31	7.955082	22980	9.999982	02	7.955100	22981	12.044900	29
32	968870	22273	999981	02	968889	22275	031111	28
33	982233	21608	999980	02	982253	21610	017747	27
34	995198	20981	999979	02	995219	20983	004781	26
35	8.007787	20390	999977	02	8.007809	20392	11.992191	25
36	020021	19831	999976	02	020045	19833	979955	24
37	031919	19302	999975	02	031945	19305	968055	23
38	043501	18801	999973	02	043527	18803	956473	22
39	054781	18325	999972	02	054809	18327	945191	21
40	065776	17872	999971	02	065806	17874	934194	20
41	8.076500	17441	9.999969	02	8.076531	17444	11.923469	19
42	086965	17031	999968	02	086997	17034	913003	18
43	097183	16639	999966	02	097217	16642	902783	17
44	107167	16265	999964	03	107202	16268	892797	16
45	116926	15908	999963	03	116963	15910	883037	15
46	126471	15566	999961	03	126510	15568	873490	14
47	135810	15238	999959	03	135851	15241	864149	13
48	144953	14924	999958	03	144996	14927	855004	12
49	153907	14622	999956	03	153952	14627	846048	11
50	162681	14333	999954	03	162727	14336	837273	10
51	8.171280	14054	9.999952	03	8.171328	14057	11.828672	9
52	179713	13786	999950	03	179763	13790	829237	8
53	187985	13529	999948	03	188036	13532	811964	7
54	196102	13280	999946	03	196156	13284	803844	6
55	204070	13041	999944	03	204126	13044	795874	5
56	211895	12810	999942	04	211953	12814	788047	4
57	219581	12587	999940	04	219641	12590	780359	3
58	227134	12372	999938	04	227195	12376	772805	2
59	234557	12164	999936	04	234621	12168	765379	1
60	241855	11963	999934	04	241921	11967	758079	0

	Cosine		Sine		Cotang.		Tang.		M.
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89 Degrees.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	M.
0	8-241855	11963	9-999934	04	8-241921	11967	11-758079	60
1	249033	11768	999932	04	249102	11772	758098	59
2	256094	11590	999929	04	256165	11584	743835	58
3	263042	11398	999927	04	263115	11402	736885	57
4	269881	11221	999925	04	269956	11225	730044	56
5	276614	11050	999922	04	276691	11054	723309	55
6	283243	10883	999920	04	283323	10887	716677	54
7	289773	10721	999918	04	289856	10726	710144	53
8	296207	10565	999915	04	296292	10570	703708	52
9	302546	10413	999913	04	302634	10418	697366	51
10	308794	10266	999910	04	308884	10270	691116	50
11	8-314954	10122	9-999907	04	8-315046	10126	11-684954	49
12	321027	9992	999905	04	321122	9987	678878	48
13	327016	9847	999902	04	327114	9851	672886	47
14	332924	9714	999899	05	333025	9719	666975	46
15	338753	9586	999897	05	338856	9590	661144	45
16	344504	9460	999894	05	344610	9465	655390	44
17	350181	9338	999891	05	350289	9343	649711	43
18	355783	9219	999888	05	355895	9224	644105	42
19	361315	9103	999885	05	361430	9108	638570	41
20	366777	8990	999882	05	366895	8995	633105	40
21	8-372171	8880	9-999879	05	8-372292	8885	11-627708	39
22	377499	8772	999876	05	377622	8777	622378	38
23	382762	8667	999873	05	382889	8672	617111	37
24	387962	8564	999870	05	388092	8570	611908	36
25	393101	8464	999867	05	393234	8470	606766	35
26	398179	8368	999864	05	398315	8371	601685	34
27	403199	8271	999861	05	403338	8276	596602	33
28	408161	8177	999858	05	408304	8182	591696	32
29	413068	8086	999854	05	413213	8091	586787	31
30	417919	7996	999851	06	418068	8002	581932	30
31	8-422717	7909	9-999848	06	8-422869	7914	11-577131	29
32	427462	7823	999844	06	427618	7830	572382	28
33	432156	7740	999841	06	432315	7745	567685	27
34	436800	7657	999838	06	436962	7663	563038	26
35	441394	7577	999834	06	441560	7583	558440	25
36	445941	7499	999831	06	446110	7505	553890	24
37	450440	7422	999827	06	450613	7428	549387	23
38	454893	7346	999823	06	455070	7352	544930	22
39	459301	7273	999820	06	459481	7279	540519	21
40	463665	7200	999816	06	463849	7206	536151	20
41	8-467985	7129	9-999812	06	8-468172	7135	11-531828	19
42	472263	7060	999809	06	472454	7066	527546	18
43	476498	6991	999805	06	476693	6998	523307	17
44	480693	6924	999801	06	480892	6931	519108	16
45	484848	6859	999797	07	485050	6865	514950	15
46	488963	6794	999793	07	489170	6801	510830	14
47	493040	6731	999790	07	493250	6738	506750	13
48	497078	6669	999786	07	497293	6676	502707	12
49	501080	6608	999782	07	501298	6615	498702	11
50	505045	6548	999778	07	505267	6555	494733	10
51	8-508974	6489	9-999774	07	8-509200	6496	11-490800	9
52	512867	6431	999769	07	513098	6439	486902	8
53	516728	6375	999765	07	516961	6382	483039	7
54	520551	6319	999761	07	520790	6326	479210	6
55	524343	6264	999757	07	524586	6272	475414	5
56	528102	6211	999753	07	528349	6218	471651	4
57	531828	6158	999748	07	532080	6165	467920	3
58	535523	6106	999744	07	535779	6113	464221	2
59	539188	6055	999740	07	539447	6062	460553	1
60	542819	6004	999735	07	543084	6012	456916	0

Cosine Sine Cotang. Tang. M.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	M.
0	8542819	6004	9999735	07	8543084	6012	11456916	60
1	546422	5955	9999731	07	546691	5962	453309	59
2	549995	5906	999726	07	550268	5914	449732	58
3	553539	5858	999722	08	553817	5866	446183	57
4	557054	5811	999717	08	557336	5819	442664	56
5	560540	5765	999713	08	560828	5773	439172	55
6	563999	5719	999708	08	564291	5727	435709	54
7	567431	5674	999704	08	567727	5682	432273	53
8	570836	5630	999699	08	571137	5638	428863	52
9	574214	5587	999694	08	574520	5595	425480	51
10	577566	5544	999689	08	577877	5552	422123	50
11	8580892	5502	9999685	08	8581208	5510	11418792	49
12	584193	5460	999680	08	584514	5468	415486	48
13	587469	5419	999675	08	587795	5427	412205	47
14	590721	5379	999670	08	591051	5387	408949	46
15	593948	5339	999665	08	594283	5347	405717	45
16	597152	5300	999660	08	597492	5308	402508	44
17	600332	5261	999655	08	600677	5270	399323	43
18	603489	5223	999650	08	603839	5232	396161	42
19	606623	5186	999645	09	606978	5194	393022	41
20	609734	5149	999640	09	610094	5158	389906	40
21	8612823	5112	9999635	09	8613189	5121	11386811	39
22	615891	5076	999629	09	616262	5085	383738	38
23	618037	5041	999624	09	619313	5050	380687	37
24	621962	5006	999619	09	622343	5015	377657	36
25	624965	4972	999614	09	625352	4981	374648	35
26	627948	4938	999608	09	628340	4947	371660	34
27	630911	4904	999603	09	631308	4913	368692	33
28	633854	4871	999597	09	634256	4880	365744	32
29	636776	4839	999592	09	637184	4848	362816	31
30	639680	4806	999586	09	640093	4816	359907	30
31	8642563	4775	9999581	09	8642982	4784	11357018	29
32	645428	4743	999575	09	645853	4753	354147	28
33	648274	4712	999570	09	648704	4722	351296	27
34	651102	4682	999564	09	651537	4691	348463	26
35	653911	4652	999558	10	654352	4661	345648	25
36	656702	4622	999553	10	657149	4631	342851	24
37	659475	4592	999547	10	659928	4602	340072	23
38	662230	4563	999541	10	662689	4573	337311	22
39	664968	4535	999535	10	665433	4544	334567	21
40	667689	4506	999529	10	668160	4526	331840	20
41	8670393	4470	9999524	10	8670870	4488	11329130	19
42	673080	4451	999518	10	673563	4461	326437	18
43	675751	4424	999512	10	676239	4434	323761	17
44	678405	4397	999506	10	678900	4417	321100	16
45	681043	4370	999500	10	681544	4380	318456	15
46	683665	4344	999493	10	684172	4354	315828	14
47	686272	4318	999487	10	686784	4328	313216	13
48	688863	4292	999481	10	689381	4303	310619	12
49	691438	4267	999475	10	691963	4277	308037	11
50	693998	4242	999469	10	694529	4252	305471	10
51	8696543	4217	9999463	11	8697081	4228	11302919	9
52	699073	4192	999456	11	699617	4203	300383	8
53	701589	4168	999450	11	702139	4179	297861	7
54	704090	4144	999443	11	704646	4155	295354	6
55	706577	4121	999437	11	707140	4132	292860	5
56	709049	4097	999431	11	709618	4108	290382	4
57	711507	4074	999424	11	712083	4085	287917	3
58	713952	4051	999418	11	714534	4062	285465	2
59	716383	4029	999411	11	716972	4040	283028	1
60	718800	4006	999404	11	719396	4017	280604	0
	Cosine		Sine		Cotang.		Tang.	M.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	M.
0	8718800	4006	9990404	11	8718396	4017	11280004	60
1	721204	3984	999306	11	721806	3995	278194	59
2	723505	3962	999391	11	724204	3974	275796	58
3	725972	3941	999364	11	726588	3952	273412	57
4	728337	3919	999378	11	728959	3930	271041	56
5	730688	3898	999371	11	731317	3909	268683	55
6	733027	3877	999364	12	733663	3889	266337	54
7	735354	3857	999357	12	735996	3868	264004	53
8	737667	3836	999350	12	738317	3848	261683	52
9	739969	3816	999343	12	740628	3827	259374	51
10	742259	3796	999336	12	742922	3807	257078	50
11	8744536	3776	9999329	12	8745807	3787	11254793	49
12	746802	3756	999322	12	747479	3768	252521	48
13	749055	3737	999315	12	749740	3749	250360	47
14	751297	3717	999308	12	751989	3729	248011	46
15	753528	3698	999301	12	754227	3710	245773	45
16	755747	3679	999294	12	756453	3692	243547	44
17	757955	3661	999286	12	758668	3673	241332	43
18	760151	3642	999279	12	760872	3655	239128	42
19	762337	3624	999272	12	763065	3636	236935	41
20	764511	3606	999265	12	765246	3618	234754	40
21	8766675	3588	9999257	12	8767417	3600	11232583	39
22	768828	3570	999250	13	769578	3583	230422	38
23	770970	3553	999242	13	771727	3565	228273	37
24	773101	3535	999235	13	773866	3548	226134	36
25	775223	3518	999227	13	775995	3531	224005	35
26	777333	3501	999220	13	778114	3514	221886	34
27	779434	3484	999212	13	780222	3497	219778	33
28	781524	3467	999205	13	782320	3480	217680	32
29	783605	3451	999197	13	784408	3464	215592	31
30	785675	3431	999189	13	786486	3447	213514	30
31	8787736	3418	9999181	13	8788554	3431	11211446	29
32	789787	3402	999174	13	790613	3414	200387	28
33	791828	3386	999166	13	792662	3399	207338	27
34	793859	3370	999158	13	794701	3383	205299	26
35	795881	3354	999150	13	796731	3368	203269	25
36	797894	3339	999142	13	798752	3352	201248	24
37	799897	3323	999134	13	800763	3337	199237	23
38	801892	3308	999126	13	802765	3322	197235	22
39	803876	3293	999118	13	804758	3307	195242	21
40	805852	3278	999110	13	806742	3292	193258	20
41	87807819	3263	9999102	13	87808717	3278	11191283	19
42	809777	3249	999094	14	810683	3262	189317	18
43	811726	3234	999086	14	812641	3248	187359	17
44	813667	3219	999077	14	814589	3233	185411	16
45	815599	3205	999069	14	816529	3219	183471	15
46	817522	3191	999061	14	818461	3205	181539	14
47	819436	3177	999053	14	820384	3191	179616	13
48	821343	3163	999044	14	822298	3177	177702	12
49	823240	3149	999036	14	824205	3163	175795	11
50	825130	3135	999027	14	826103	3150	173897	10
51	87827011	3122	9999010	14	87827092	3136	11172008	9
52	826884	3108	999010	14	828674	3123	170126	8
53	830749	3095	999002	14	831748	3110	168252	7
54	832607	3082	998993	14	833613	3096	166387	6
55	834456	3069	998984	14	835471	3083	164529	5
56	836297	3056	998976	14	837321	3070	162679	4
57	838130	3043	998967	15	839163	3057	160837	3
58	839956	3030	998958	15	840998	3045	159002	2
59	841774	3017	998950	15	842825	3032	157175	1
60	843585	3000	998941	15	844644	3019	155356	0
	Cosine		Sine		Cotang.		Tang.	M.

86 Degrees.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	M.
0	8843585	3005	9998941	15	8844044	3010	11155356	60
1	845387	2992	998932	15	846455	3007	153545	59
2	847183	2980	998923	15	848260	2995	151740	58
3	848971	2967	998914	15	850057	2982	149943	57
4	850751	2955	998905	15	851846	2970	148154	56
5	852525	2943	998896	15	853632	2958	146372	55
6	854291	2931	998887	15	855403	2946	144597	54
7	856049	2919	998878	15	857171	2935	142829	53
8	857801	2907	998869	15	858932	2923	141068	52
9	859546	2896	998860	15	860686	2911	139314	51
10	861283	2884	998851	15	862433	2900	137567	50
11	863014	2873	998841	15	864173	2888	11135827	49
12	864738	2861	998832	15	865906	2877	134094	48
13	866455	2850	998823	16	867632	2866	132368	47
14	868165	2839	998813	16	869351	2854	130649	46
15	869868	2828	998804	16	871064	2843	128936	45
16	871565	2817	998795	16	872770	2832	127230	44
17	873255	2806	998785	16	874469	2821	125531	43
18	874938	2795	998776	16	876162	2811	123838	42
19	876615	2786	998766	16	877849	2800	122151	41
20	878285	2773	998757	16	879529	2789	120471	40
21	879940	2763	998747	16	881202	2779	1118798	39
22	881607	2752	998738	16	882869	2768	117131	38
23	883258	2742	998728	16	884530	2758	115470	37
24	884903	2731	998718	16	886185	2747	113815	36
25	886542	2721	998708	16	887833	2737	112167	35
26	888174	2711	998699	16	889476	2727	110524	34
27	889801	2700	998689	16	891112	2717	108888	33
28	891421	2690	998679	16	892742	2707	107258	32
29	893035	2680	998669	17	894366	2697	105634	31
30	894643	2670	998659	17	895984	2687	104016	30
31	896246	2660	998649	17	897596	2677	11102404	29
32	897842	2651	998639	17	899203	2667	100797	28
33	899432	2641	998629	17	900803	2658	099197	27
34	901017	2631	998619	17	902398	2648	097602	26
35	902596	2622	998609	17	903987	2638	096013	25
36	904169	2612	998599	17	905570	2629	094430	24
37	905736	2603	998589	17	907147	2620	092853	23
38	907297	2593	998578	17	908719	2610	091281	22
39	908853	2584	998568	17	910285	2601	089715	21
40	910404	2575	998558	17	911846	2592	088154	20
41	911949	2566	998548	17	913401	2583	11086599	19
42	913488	2556	998537	17	914951	2574	085049	18
43	915022	2547	998527	17	916495	2565	083505	17
44	916550	2538	998516	18	918034	2556	081966	16
45	918073	2529	998506	18	919568	2547	080432	15
46	919591	2520	998495	18	921096	2538	078904	14
47	921103	2512	998485	18	922619	2530	077381	13
48	922610	2503	998474	18	924136	2521	075864	12
49	924112	2494	998464	18	925649	2512	074351	11
50	925609	2486	998453	18	927156	2503	072844	10
51	927100	2477	998442	18	928658	2495	11071342	9
52	928587	2469	998431	18	930155	2486	069845	8
53	930068	2460	998421	18	931647	2478	068353	7
54	931544	2452	998410	18	933134	2470	066866	6
55	933015	2443	998399	18	934616	2461	065384	5
56	934481	2435	998388	18	936093	2453	063907	4
57	935942	2427	998377	18	937565	2445	062435	3
58	937398	2419	998366	18	939032	2437	060968	2
59	938850	2411	998355	18	940494	2430	059506	1
60	940296	2403	998344	18	941952	2421	058048	0

	Cosine		Sine		Cotang.		Tang.		M.
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85 Degrees.

LOGARITHMIC SINES, COSINES, ETC. (5 Degrees.)

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.
0	8-940296	2403	9-998344	19	8-941952	2421	11-058048
1	941738	2394	998333	19	943404	2413	056596
2	943174	2387	998322	19	944852	2405	055148
3	944606	2379	998311	19	946295	2397	053705
4	946034	2371	998300	19	947734	2390	052266
5	947456	2363	998289	19	949168	2382	050832
6	948874	2355	998277	19	950597	2374	049403
7	950287	2348	998266	19	952021	2366	047979
8	951696	2340	998255	19	953441	2360	046559
9	953100	2332	998243	19	954856	2351	045144
10	954499	2325	998232	19	956267	2344	043733
11	8-955894	2317	9-998220	19	8-957674	2337	11-042326
12	957284	2310	998209	19	959075	2329	040925
13	958670	2302	998197	19	960473	2323	039527
14	960052	2295	998186	19	961866	2314	038134
15	961429	2288	998174	19	963255	2307	036745
16	962801	2280	998163	19	964639	2300	035361
17	964170	2273	998151	19	966019	2293	033981
18	965534	2266	998139	20	967394	2286	032606
19	966893	2259	998128	20	968766	2279	031234
20	968249	2252	998116	20	970133	2271	029867
21	8-969600	2244	9-998104	20	8-971496	2265	11-028504
22	970947	2238	998092	20	972855	2257	027145
23	972289	2231	998080	20	974209	2251	025791
24	973628	2224	998068	20	975560	2244	024440
25	974962	2217	998056	20	976906	2237	023094
26	976293	2210	998044	20	978248	2230	021752
27	977619	2203	998032	20	979586	2223	020414
28	978941	2197	998020	20	980921	2217	019079
29	980259	2190	998008	20	982251	2210	017749
30	981573	2183	997996	20	983577	2204	016423
31	8-982883	2177	9-997984	20	8-984899	2197	11-015101
32	984189	2170	997972	20	986217	2191	013783
33	985491	2163	997959	20	987532	2184	012468
34	986780	2157	997947	20	988842	2178	011158
35	988063	2150	997935	21	990149	2171	009851
36	989374	2144	997922	21	991451	2165	008549
37	990660	2138	997910	21	992750	2158	007250
38	991943	2131	997897	21	994045	2152	005955
39	993222	2125	997885	21	995337	2146	004663
40	994497	2119	997872	21	996624	2140	003376
41	8-995768	2112	9-997860	21	8-997908	2134	11-002092
42	997036	2106	997847	21	999188	2127	000812
43	998299	2100	997835	21	9-000465	2121	10-999535
44	999560	2094	997822	21	001738	2115	998262
45	9-000816	2087	997809	21	003007	2109	996993
46	002069	2082	997797	21	004272	2103	995728
47	003318	2076	997784	21	005534	2097	994466
48	004563	2070	997771	21	006792	2091	993208
49	005805	2064	997758	21	008047	2085	991953
50	007044	2058	997745	21	009298	2080	990702
51	9-008278	2052	9-997732	21	9-010546	2074	10-989454
52	009510	2046	997719	21	011790	2068	988210
53	010737	2040	997706	21	013031	2062	986969
54	011962	2034	997693	22	014268	2056	985732
55	013182	2029	997680	22	015502	2051	984498
56	014400	2023	997667	22	016732	2045	983268
57	015613	2017	997654	22	017959	2040	982041
58	016824	2012	997641	22	019183	2033	980817
59	018031	2006	997628	22	020403	2028	979597
60	019235	2000	997614	22	021620	2023	978380
	Cosine		Sine		Cotang.		Tang.

84 Degrees.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	M.
0	9-019235	2000	9-997614	22	9-021620	2023	10-978380	60
1	020435	1995	997601	22	022834	2017	977166	59
2	021632	1989	997588	22	024044	2011	975956	58
3	022825	1984	997574	22	025251	2006	974749	57
4	024016	1978	997561	22	026455	2000	973545	56
5	025203	1973	997547	22	027655	1995	972345	55
6	026386	1967	997534	23	028852	1990	971148	54
7	027567	1962	997520	23	030046	1985	969954	53
8	028744	1957	997507	23	031237	1979	968763	52
9	029918	1951	997493	23	032425	1974	967575	51
10	031089	1947	997480	23	033609	1969	966391	50
11	9-032257	1941	9-997466	23	9-034791	1964	10-965209	49
12	033421	1936	997452	22	035969	1958	964031	48
13	034582	1930	997439	23	037144	1953	962856	47
14	035741	1925	997425	23	038316	1948	961684	46
15	036896	1920	997411	23	039485	1943	960515	45
16	038048	1915	997397	23	040651	1938	959349	44
17	039197	1910	997383	23	041813	1933	958187	43
18	040342	1905	997369	23	042973	1928	957027	42
19	041485	1899	997355	23	044130	1923	955870	41
20	042625	1894	997341	23	045284	1918	954716	40
21	9-043762	1889	9-997327	24	9-046434	1913	10-953566	39
22	044895	1884	997313	24	047582	1908	952418	38
23	046026	1879	997299	24	048727	1903	951273	37
24	047154	1875	997285	24	049869	1898	950131	36
25	048279	1870	997271	24	051008	1893	948992	35
26	049400	1865	997257	24	052144	1889	947856	34
27	050519	1860	997242	24	053277	1884	946723	33
28	051635	1855	997228	24	054407	1879	945593	32
29	052749	1850	997214	24	055535	1874	944465	31
30	053859	1845	997199	24	056659	1870	943341	30
31	054966	1841	9-997185	24	9-057781	1865	10-942219	29
32	056071	1836	997170	24	058900	1860	941100	28
33	057172	1831	997156	24	060016	1855	939984	27
34	058271	1827	997141	24	061130	1851	938870	26
35	059367	1822	997127	24	062240	1846	937760	25
36	060460	1817	997112	24	063348	1842	936652	24
37	061551	1813	997098	24	064453	1837	935547	23
38	062639	1808	997083	25	065556	1833	934444	22
39	063724	1804	997068	25	066655	1828	933345	21
40	064806	1799	997053	25	067752	1824	932248	20
41	9-065885	1794	9-997039	25	9-068846	1819	10-931154	19
42	066962	1790	997024	25	069938	1815	930062	18
43	068036	1786	997009	25	071027	1810	928973	17
44	069107	1781	996994	25	072113	1806	927887	16
45	070176	1777	996979	25	073197	1802	926803	15
46	071242	1772	996964	25	074278	1797	925722	14
47	072306	1768	996949	25	075356	1793	924644	13
48	073366	1763	996934	25	076432	1789	923568	12
49	074424	1759	996919	25	077505	1784	922495	11
50	075480	1755	996904	25	078576	1780	921424	10
51	9-076533	1750	9-996889	25	9-079644	1776	10-920356	9
52	077583	1746	996874	25	080710	1772	919290	8
53	078631	1742	996858	25	081773	1767	918227	7
54	079676	1738	996843	25	082833	1763	917167	6
55	080719	1733	996828	25	083891	1759	916109	5
56	081759	1729	996812	26	084947	1755	915053	4
57	082797	1725	996797	26	086000	1751	914000	3
58	083832	1721	996782	26	087050	1747	912950	2
59	084864	1717	996766	26	088098	1743	911902	1
60	085894	1713	996751	26	089144	1738	910856	0

Cosine

Sine

Cotang.

Tang.

M.

63 Degrees.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	M.
0	9-085804	1713	9-996751	26	9-089144	1738	10-910666	60
1	086922	1709	996735	26	090187	1734	909813	59
2	087947	1704	996720	26	091228	1730	908772	58
3	088970	1700	996704	26	092266	1727	907734	57
4	089990	1696	996688	26	093302	1722	906698	56
5	091008	1692	996673	26	094336	1719	905664	55
6	092024	1688	996657	26	095367	1715	904633	54
7	093037	1684	996641	26	096395	1711	903603	53
8	094047	1680	996625	26	097422	1707	902578	52
9	095056	1676	996610	26	098446	1703	901554	51
10	096062	1673	996594	26	099468	1699	900532	50
11	9-097065	1669	9-996578	27	9-100487	1695	10-899513	49
12	098066	1665	996562	27	101504	1691	898496	48
13	099065	1661	996546	27	102519	1687	897481	47
14	100062	1657	996530	27	103532	1684	896468	46
15	101056	1653	996514	27	104542	1680	895458	45
16	102048	1649	996498	27	105550	1676	894450	44
17	103037	1645	996482	27	106556	1672	893444	43
18	104025	1641	996465	27	107559	1669	892441	42
19	105010	1638	996449	27	108560	1665	891440	41
20	105992	1634	996433	27	109559	1661	890441	40
21	9-106973	1630	9-996417	27	9-110556	1658	10-889444	39
22	107951	1627	996400	27	111551	1654	888449	38
23	108927	1623	996384	27	112543	1650	887457	37
24	109901	1619	996368	27	113533	1646	886467	36
25	110873	1616	996351	27	114521	1643	885479	35
26	111842	1612	996335	27	115507	1639	884493	34
27	112809	1608	996318	27	116491	1636	883509	33
28	113774	1605	996302	28	117472	1632	882528	32
29	114737	1601	996285	28	118452	1629	881548	31
30	115698	1597	996269	28	119429	1625	880571	30
31	9-116656	1594	9-996252	28	9-120404	1622	10-879596	29
32	117613	1590	996235	28	121377	1618	878623	28
33	118567	1587	996219	28	122348	1615	877652	27
34	119519	1583	996202	28	123317	1611	876683	26
35	120469	1580	996185	28	124284	1607	875716	25
36	121417	1576	996168	28	125249	1604	874751	24
37	122362	1573	996151	28	126211	1601	873789	23
38	123306	1569	996134	28	127172	1597	872828	22
39	124248	1566	996117	28	128130	1594	871870	21
40	125187	1562	996100	28	129087	1591	870913	20
41	9-126125	1559	9-996083	29	9-130041	1587	10-869939	19
42	127060	1556	996066	29	130994	1584	869006	18
43	127993	1552	996049	29	131944	1581	868056	17
44	128925	1549	996032	29	132893	1577	867107	16
45	129854	1545	996015	29	133839	1574	866161	15
46	130781	1542	995998	29	134784	1571	865216	14
47	131706	1539	995980	29	135726	1567	864274	13
48	132630	1535	995963	29	136667	1564	863333	12
49	133551	1532	995946	29	137605	1561	862395	11
50	134470	1529	995928	29	138542	1558	861458	10
51	9-135387	1525	9-995911	29	9-139476	1555	10-860524	9
52	136303	1522	995894	29	140409	1551	859591	8
53	137216	1519	995876	29	141340	1548	858660	7
54	138128	1516	995859	29	142269	1545	857731	6
55	139037	1512	995841	29	143196	1542	856804	5
56	139944	1509	995823	29	144121	1539	855879	4
57	140850	1506	995806	29	145044	1535	854956	3
58	141754	1503	995788	29	145966	1532	854034	2
59	142655	1500	995771	29	146885	1529	853115	1
60	143555	1496	995753	29	147803	1526	852197	0
	Cosine		Sine		Cotang.		Tang.	M.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	M.
0	9-143555	1496	9-995753	30	9-147803	1526	10-852197	60
1	144453	1493	995735	30	148718	1523	851292	59
2	145349	1490	995717	30	149632	1520	850368	58
3	146243	1487	995699	30	150544	1517	849456	57
4	147136	1484	995681	30	151454	1514	848546	56
5	148026	1481	995664	30	152363	1511	847637	55
6	148915	1478	995646	30	153269	1508	846731	54
7	149802	1475	995628	30	154174	1505	845826	53
8	150686	1472	995610	30	155077	1502	844923	52
9	151569	1469	995591	30	155978	1499	844022	51
10	152451	1466	995573	30	156877	1496	843123	50
11	9-153330	1463	9-995555	30	9-157775	1493	10-842225	49
12	154208	1460	995537	30	158671	1490	841329	48
13	155083	1457	995519	30	159565	1487	840435	47
14	155957	1454	995501	31	160457	1484	839543	46
15	156830	1451	995482	31	161347	1481	838653	45
16	157700	1448	995464	31	162236	1479	837764	44
17	158569	1445	995446	31	163123	1476	836877	43
18	159435	1442	995427	31	164008	1473	835992	42
19	160301	1439	995409	31	164892	1470	835108	41
20	161164	1436	995390	31	165774	1467	834226	40
21	9-162025	1433	9-995372	31	9-166654	1464	10-833346	39
22	162885	1430	995353	31	167532	1461	832468	38
23	163743	1427	995334	31	168409	1458	831591	37
24	164600	1424	995316	31	169284	1455	830716	36
25	165454	1422	995297	31	170157	1453	829843	35
26	166307	1419	995278	31	171029	1450	828971	34
27	167159	1416	995260	31	171899	1447	828101	33
28	168008	1413	995241	32	172767	1444	827233	32
29	168856	1410	995222	32	173634	1442	826366	31
30	169702	1407	995203	32	174499	1439	825501	30
31	9-170547	1405	9-995184	32	9-175362	1436	10-824638	29
32	171389	1402	995165	32	176224	1433	823776	28
33	172230	1399	995146	32	177084	1431	822916	27
34	173070	1396	995127	32	177942	1428	822058	26
35	173908	1394	995108	32	178799	1425	821201	25
36	174744	1391	995089	32	179655	1423	820345	24
37	175578	1388	995070	32	180508	1420	819492	23
38	176411	1386	995051	32	181360	1417	818640	22
39	177242	1383	995032	32	182211	1415	817789	21
40	178072	1380	995013	32	183059	1412	816941	20
41	9-178900	1377	9-994993	32	9-183907	1409	10-816093	19
42	179726	1374	994974	32	184752	1407	815248	18
43	180551	1372	994955	32	185597	1404	814403	17
44	181374	1369	994935	32	186439	1402	813561	16
45	182196	1366	994916	33	187280	1399	812720	15
46	183016	1364	994896	33	188120	1396	811880	14
47	183834	1361	994877	33	188958	1393	811042	13
48	184651	1359	994857	33	189794	1391	810206	12
49	185466	1356	994838	33	190629	1389	809371	11
50	186280	1353	994818	33	191462	1386	808538	10
51	9-187092	1351	9-994798	33	9-192294	1384	10-807706	9
52	187903	1348	994779	33	193124	1381	806876	8
53	188712	1346	994759	33	193953	1379	806047	7
54	189519	1343	994739	33	194780	1376	805220	6
55	190325	1341	994719	33	195606	1374	804394	5
56	191130	1338	994700	33	196430	1371	803570	4
57	191933	1336	994680	33	197253	1369	802747	3
58	192734	1333	994660	33	198074	1366	801926	2
59	193534	1330	994640	33	198894	1364	801106	1
60	194332	1328	994620	33	199713	1361	800287	0
	Cosine		Sine		Cotang.		Tang.	M.

LOGARITHMIC SINES, COSINES, ETC. (9 Degrees.)

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.
0	9-194332	1328	9-994620	33	9-199713	1361	10-800287
1	195129	1326	994600	33	200529	1359	799471
2	195925	1323	994580	33	201345	1356	798655
3	196719	1321	994560	34	202159	1354	797841
4	197511	1318	994540	34	202971	1352	797029
5	198302	1316	994519	34	203782	1349	796218
6	199091	1313	994499	34	204592	1347	795408
7	199879	1311	994479	34	205400	1345	794600
8	200666	1308	994459	34	206207	1342	793793
9	201451	1306	994438	34	207013	1340	792987
10	202234	1304	994418	34	207817	1338	792183
11	9-203017	1301	9-994397	34	9-208619	1335	10-791381
12	203797	1299	994377	34	209420	1333	790580
13	204577	1296	994357	34	210220	1331	789780
14	205354	1294	994336	34	211018	1328	788982
15	206131	1292	994316	34	211815	1326	788185
16	206906	1289	994295	34	212611	1324	787389
17	207679	1287	994274	35	213405	1321	786595
18	208452	1285	994254	35	214198	1319	785802
19	209222	1282	994233	35	214989	1317	785011
20	209992	1280	994212	35	215780	1315	784220
21	9-210760	1278	9-994191	35	9-216568	1312	10-783432
22	211526	1275	994171	35	217356	1310	782644
23	212291	1273	994150	35	218142	1308	781858
24	213055	1271	994129	35	218928	1305	781074
25	213818	1268	994108	35	219710	1303	780290
26	214579	1266	994087	35	220492	1301	779508
27	215338	1264	994066	35	221272	1299	778728
28	216097	1261	994045	35	222052	1297	777948
29	216854	1259	994024	35	222830	1294	777170
30	217609	1257	994003	35	223606	1292	776394
31	9-218363	1255	9-993981	35	9-224382	1290	10-775618
32	219116	1253	993960	35	225156	1288	774844
33	219868	1250	993939	35	225929	1286	774071
34	220618	1248	993918	35	226700	1284	773300
35	221367	1246	993896	36	227471	1281	772529
36	222115	1244	993875	36	228239	1279	771761
37	222861	1242	993854	36	229007	1277	770993
38	223606	1239	993832	36	229773	1275	770227
39	224349	1237	993811	36	230539	1273	769461
40	225092	1235	993789	36	231302	1271	768698
41	9-225833	1233	9-993768	36	9-232065	1269	10-767935
42	226573	1231	993746	36	232826	1267	767174
43	227311	1228	993725	36	233586	1265	766414
44	228048	1226	993703	36	234345	1262	765655
45	228784	1224	993681	36	235103	1260	764897
46	229518	1222	993660	36	235859	1258	764141
47	230252	1220	993638	36	236614	1256	763386
48	230984	1218	993616	36	237368	1254	762632
49	231714	1216	993594	37	238120	1252	761880
50	232444	1214	993572	37	238872	1250	761128
51	9-233172	1212	9-993550	37	9-239622	1248	10-760378
52	233899	1209	993528	37	240371	1246	759629
53	234625	1207	993506	37	241118	1244	758882
54	235349	1205	993484	37	241865	1242	758135
55	236073	1203	993462	37	242610	1240	757390
56	236795	1201	993440	37	243354	1238	756646
57	237515	1199	993418	37	244097	1236	755903
58	238235	1197	993396	37	244839	1234	755161
59	238953	1195	993374	37	245579	1232	754421
60	239670	1193	993351	37	246319	1230	753681
	Cosine		Sine		Cotang.		Tang.

80 Degrees.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9-239670	1183	9-993351	37	9-246319	1230	10-759681	60
1	240386	1191	993329	37	247057	1228	759243	59
2	241101	1189	993307	37	247794	1226	759206	58
3	241814	1187	993285	37	248530	1224	751470	57
4	242526	1185	993262	37	249264	1222	750736	56
5	243237	1183	993240	37	249998	1220	750002	55
6	243947	1181	993217	38	250730	1218	749270	54
7	244656	1179	993195	38	251461	1217	748539	53
8	245363	1177	993172	38	252191	1215	747809	52
9	246069	1175	993149	38	252920	1213	747080	51
10	246775	1173	993127	38	253648	1211	746352	50
11	9-247478	1171	9-993104	38	9-254374	1209	10-745626	49
12	248181	1169	993081	38	255100	1207	744900	48
13	248883	1167	993059	38	255824	1205	744176	47
14	249583	1165	993036	38	256547	1203	743453	46
15	250282	1163	993013	38	257269	1201	742731	45
16	250980	1161	992990	38	257990	1200	742010	44
17	251677	1159	992967	38	258710	1198	741290	43
18	252373	1158	992944	38	259429	1196	740571	42
19	253067	1156	992921	38	260146	1194	739854	41
20	253761	1154	992898	38	260863	1192	739137	40
21	9-254453	1152	9-992875	38	9-261578	1190	10-738422	39
22	255144	1150	992852	38	262292	1189	737708	38
23	255834	1148	992829	39	263005	1187	736995	37
24	256523	1146	992806	39	263717	1185	736283	36
25	257211	1144	992783	39	264428	1183	735572	35
26	257898	1142	992759	39	265138	1181	734862	34
27	258583	1141	992736	39	265847	1179	734153	33
28	259268	1139	992713	39	266555	1178	733445	32
29	259951	1137	992690	39	267261	1176	732739	31
30	260633	1135	992666	39	267967	1174	732033	30
31	9-261314	1133	9-992643	39	9-268671	1172	10-731329	29
32	261994	1131	992619	39	269375	1170	730625	28
33	262673	1130	992596	39	270077	1169	729923	27
34	263351	1128	992572	39	270779	1167	729221	26
35	264027	1126	992549	39	271479	1165	728521	25
36	264703	1124	992525	39	272178	1164	727822	24
37	265377	1122	992501	39	272876	1162	727124	23
38	266051	1120	992478	40	273573	1160	726427	22
39	266723	1119	992454	40	274269	1158	725731	21
40	267395	1117	992430	40	274964	1157	725036	20
41	9-268065	1115	9-992406	40	9-275658	1155	10-724342	19
42	268734	1113	992382	40	276351	1153	723649	18
43	269402	1111	992359	40	277043	1151	722957	17
44	270069	1110	992335	40	277734	1150	722266	16
45	270735	1108	992311	40	278424	1148	721576	15
46	271400	1106	992287	40	279113	1147	720887	14
47	272064	1105	992263	40	279801	1145	720199	13
48	272726	1103	992239	40	280488	1143	719512	12
49	273388	1101	992214	40	281174	1141	718826	11
50	274049	1099	992190	40	281858	1140	718142	10
51	9-274708	1098	9-992166	40	9-282542	1138	10-717458	9
52	275367	1096	992142	40	283225	1136	716775	8
53	276024	1094	992117	41	283907	1135	716093	7
54	276681	1092	992093	41	284588	1133	715412	6
55	277337	1091	992069	41	285268	1131	714732	5
56	277991	1089	992044	41	285947	1130	714053	4
57	278644	1087	992020	41	286624	1128	713376	3
58	279297	1086	991996	41	287301	1126	712699	2
59	279948	1084	991971	41	287977	1125	712023	1
60	280599	1082	991947	41	288652	1123	711348	0

Cosine

Sine

Cotang.

Tang.

M.

79 Degrees.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9-280591	1082	9-991947	41	9-288652	1123	10-711348	60
1	281248	1081	991922	41	289326	1122	710674	59
2	281897	1079	991897	41	289999	1120	710001	58
3	282544	1077	991873	41	290671	1118	709329	57
4	283190	1076	991848	41	291342	1117	708658	56
5	283836	1074	991823	41	292013	1115	707987	55
6	284480	1072	991799	41	292682	1114	707318	54
7	285124	1071	991774	42	293350	1112	706650	53
8	285766	1069	991749	42	294017	1111	705983	52
9	286408	1067	991724	42	294684	1109	705316	51
10	287048	1066	991699	42	295349	1107	704651	50
11	9-287687	1064	9-991674	42	9-296013	1106	10-703987	49
12	288326	1063	991649	42	296677	1104	703323	48
13	288964	1061	991624	42	297339	1103	702661	47
14	289600	1059	991599	42	298001	1101	701999	46
15	290236	1058	991574	42	298662	1100	701338	45
16	290870	1056	991549	42	299322	1098	700678	44
17	291504	1054	991524	42	299980	1096	700020	43
18	292137	1053	991498	42	300638	1095	699362	42
19	292768	1051	991473	42	301295	1093	698705	41
20	293399	1050	991448	42	301951	1092	698049	40
21	9-294029	1048	9-991422	42	9-302607	1090	10-697393	39
22	294658	1046	991397	42	303261	1089	696739	38
23	295286	1045	991372	43	303914	1087	696086	37
24	295913	1043	991346	43	304567	1086	695433	36
25	296539	1042	991321	43	305218	1084	694782	35
26	297164	1040	991295	43	305869	1083	694131	34
27	297788	1039	991270	43	306519	1081	693481	33
28	298412	1037	991244	43	307168	1080	692832	32
29	299034	1036	991218	43	307815	1078	692185	31
30	299655	1034	991193	43	308463	1077	691537	30
31	9-300276	1032	9-991167	43	9-309109	1075	10-690891	29
32	300895	1031	991141	43	309754	1074	690246	28
33	301514	1029	991115	43	310398	1073	689602	27
34	302132	1028	991090	43	311042	1071	688958	26
35	302748	1026	991064	43	311685	1070	688315	25
36	303364	1025	991038	43	312327	1068	687673	24
37	303979	1023	991012	43	312967	1067	687033	23
38	304593	1022	990986	43	313608	1065	686392	22
39	305207	1020	990960	43	314247	1064	685753	21
40	305819	1019	990934	44	314885	1062	685115	20
41	9-306430	1017	9-990908	44	9-315523	1061	10-684477	19
42	307041	1016	990882	44	316159	1060	683841	18
43	307650	1014	990855	44	316795	1058	683205	17
44	308259	1013	990829	44	317430	1057	682570	16
45	308867	1011	990803	44	318064	1055	681936	15
46	309474	1010	990777	44	318697	1054	681303	14
47	310080	1008	990750	44	319329	1053	680671	13
48	310685	1007	990724	44	319961	1051	680039	12
49	311289	1005	990697	44	320592	1050	679408	11
50	311893	1004	990671	44	321222	1048	678778	10
51	9-312495	1003	9-990644	44	9-321851	1047	10-678149	9
52	313097	1001	990618	44	322479	1045	677521	8
53	313698	1000	990591	44	323106	1044	676894	7
54	314297	998	990565	44	323733	1043	676267	6
55	314897	997	990538	44	324358	1041	675642	5
56	315495	996	990511	45	324982	1040	675017	4
57	316092	994	990485	45	325607	1039	674393	3
58	316689	993	990458	45	326231	1037	673769	2
59	317284	991	990431	45	326853	1036	673147	1
60	317879	990	990404	45	327475	1035	672525	0
	Cosine		Sine		Cotang.		Tang.	M.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9-317879	990	9-990404	45	9-327474	1035	10-672526	60
1	318473	988	990378	45	328095	1033	671905	59
2	319066	987	990351	45	328715	1032	671285	58
3	319658	986	990324	45	329334	1030	670666	57
4	320249	984	990297	45	329953	1029	670047	56
5	320840	983	990270	45	330570	1028	669430	55
6	321430	982	990243	45	331187	1026	668813	54
7	322019	980	990215	45	331803	1025	668197	53
8	322607	979	990188	45	332418	1024	667582	52
9	323194	977	990161	45	333033	1023	666967	51
10	323780	976	990134	45	333646	1021	666354	50
11	9-324366	975	9-990107	46	9-334259	1020	10-665741	49
12	324950	973	990079	46	334871	1019	665129	48
13	325534	972	990052	46	335482	1017	664518	47
14	326117	970	990025	46	336093	1016	663907	46
15	326700	969	989997	46	336702	1015	663298	45
16	327281	968	989970	46	337311	1013	662689	44
17	327862	966	989942	46	337919	1012	662081	43
18	328442	965	989915	46	338527	1011	661473	42
19	329021	964	989887	46	339133	1010	660867	41
20	329599	962	989860	46	339739	1008	660261	40
21	9-330176	961	9-989832	46	9-340344	1007	10-659656	39
22	330753	960	989804	46	340948	1006	659052	38
23	331329	958	989777	46	341552	1004	658448	37
24	331903	957	989749	47	342155	1003	657845	36
25	332478	956	989721	47	342757	1002	657243	35
26	333051	954	989693	47	343358	1000	656642	34
27	333624	953	989665	47	343958	999	656042	33
28	334195	952	989637	47	344558	998	655442	32
29	334766	950	989609	47	345157	997	654843	31
30	335337	949	989582	47	345755	996	654245	30
31	9-335906	948	9-989553	47	9-346353	994	10-653647	29
32	336475	946	989525	47	346949	993	653051	28
33	337043	945	989497	47	347545	992	652455	27
34	337610	944	989469	47	348141	991	651859	26
35	338176	943	989441	47	348735	990	651265	25
36	338742	941	989413	47	349329	988	650671	24
37	339306	940	989384	47	349922	987	650078	23
38	339871	939	989356	47	350514	986	649486	22
39	340434	937	989328	47	351106	985	648894	21
40	340996	936	989300	47	351697	983	648303	20
41	9-341558	935	9-989271	47	9-352287	982	10-647713	19
42	342119	934	989243	47	352876	981	647124	18
43	342679	932	989214	47	353465	980	646535	17
44	343239	931	989186	47	354053	979	645947	16
45	343797	930	989157	47	354640	977	645360	15
46	344355	929	989128	48	355227	976	644773	14
47	344912	927	989100	48	355813	975	644187	13
48	345469	926	989071	48	356398	974	643602	12
49	346024	925	989042	48	356982	973	643018	11
50	346579	924	989014	48	357566	971	642434	10
51	9-347134	922	9-988985	48	9-358149	970	10-641851	9
52	347687	921	988956	48	358731	969	641269	8
53	348240	920	988927	48	359313	968	640687	7
54	348792	919	988898	48	359893	967	640107	6
55	349343	917	988869	48	360474	966	639526	5
56	349893	916	988840	48	361053	965	638947	4
57	350443	915	988811	49	361632	963	638368	3
58	350992	914	988782	49	362210	962	637790	2
59	351540	913	988753	49	362787	961	637213	1
60	352088	911	988724	49	363364	960	636636	0

Cosine Sine Cotang. Tang. M.

77 Degrees.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9-352088	911	9-988724	49	9-363364	960	10-636636	60
1	352635	910	988685	49	363940	959	636060	59
2	353181	909	988646	49	364515	958	635485	58
3	353726	908	988606	49	365090	957	634910	57
4	354271	907	988567	49	365664	955	634336	56
5	354815	905	988528	49	366237	954	633763	55
6	355358	904	988488	49	366810	953	633190	54
7	355901	903	988449	49	367382	952	632618	53
8	356443	902	988409	49	367953	951	632047	52
9	356984	901	988369	49	368524	950	631476	51
10	357524	899	988330	49	369094	949	630906	50
11	9-358064	898	9-988401	49	9-369663	948	10-630337	49
12	358603	897	988371	49	370232	946	629768	48
13	359141	896	988342	49	370799	945	629201	47
14	359678	895	988312	50	371367	944	628633	46
15	360215	893	988282	50	371933	943	628067	45
16	360752	892	988252	50	372499	942	627501	44
17	361287	891	988223	50	373064	941	626936	43
18	361822	890	988193	50	373629	940	626371	42
19	362356	889	988163	50	374193	939	625807	41
20	362889	888	988133	50	374756	938	625244	40
21	9-363422	887	9-988103	50	9-375319	937	10-624681	39
22	363954	885	988073	50	375881	935	624119	38
23	364485	884	988043	50	376442	934	623558	37
24	365016	883	988013	50	377003	933	622997	36
25	365546	882	987983	50	377563	932	622437	35
26	366075	881	987953	50	378122	931	621878	34
27	366604	880	987922	50	378681	930	621319	33
28	367131	879	987892	50	379239	929	620761	32
29	367659	877	987862	50	379797	928	620203	31
30	368185	876	987832	51	380354	927	619646	30
31	9-368711	875	9-987801	51	9-380910	926	10-619080	29
32	369236	874	987771	51	381466	925	618534	28
33	369761	873	987740	51	382020	924	617980	27
34	370285	872	987710	51	382575	923	617425	26
35	370808	871	987679	51	383129	922	616871	25
36	371330	870	987649	51	383682	921	616318	24
37	371852	869	987618	51	384234	920	615766	23
38	372373	867	987588	51	384786	919	615214	22
39	372894	866	987557	51	385337	918	614663	21
40	373414	865	987526	51	385888	917	614112	20
41	9-373933	864	9-987496	51	9-386438	915	10-613562	19
42	374452	863	987465	51	386987	914	613013	18
43	374970	862	987434	51	387536	913	612464	17
44	375487	861	987403	52	388084	912	611916	16
45	376003	860	987372	52	388631	911	611369	15
46	376519	859	987341	52	389178	910	610822	14
47	377035	858	987310	52	389724	909	610276	13
48	377549	857	987279	52	390270	908	609730	12
49	378063	856	987248	52	390815	907	609185	11
50	378577	854	987217	52	391360	906	608640	10
51	9-379089	853	9-987186	52	9-391903	905	10-608097	9
52	379601	852	987155	52	392447	904	607553	8
53	380113	851	987124	52	392989	903	607011	7
54	380624	850	987092	52	393531	902	606469	6
55	381134	849	987061	52	394073	901	605927	5
56	381643	848	987030	52	394614	900	605386	4
57	382152	847	986998	52	395154	899	604846	3
58	382661	846	986967	52	395694	898	604306	2
59	383168	845	986936	52	396233	897	603767	1
60	383675	844	986904	52	396771	896	603229	0

Cosine Sine Cotang. Tang. M.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9-383675	844	9-986904	52	9-396771	896	10-603229	00
1	384182	843	986873	53	397309	896	002691	50
2	384687	842	986841	53	397846	895	002154	58
3	385192	841	986809	53	398383	894	601617	57
4	385697	840	986778	53	398919	893	601081	56
5	386201	839	986746	53	399455	892	600545	55
6	386704	838	986714	53	399990	891	600010	54
7	387207	837	986683	53	400524	890	599476	53
8	387709	836	986651	53	401058	889	598942	52
9	388210	835	986619	53	401591	888	598409	51
10	388711	834	986587	53	402124	887	597876	50
11	9-389211	833	9-986555	53	9-402656	886	10-597344	49
12	389711	832	986523	53	403187	885	596813	48
13	390210	831	986491	53	403718	884	596282	47
14	390708	830	986459	53	404249	883	595751	46
15	391206	828	986427	53	404778	882	595222	45
16	391703	827	986395	53	405308	881	594692	44
17	392199	826	986363	54	405836	880	594164	43
18	392695	825	986331	54	406364	879	593636	42
19	393191	824	986299	54	406892	878	593108	41
20	393685	823	986266	54	407419	877	592581	40
21	9-394179	822	9-986234	54	9-407945	876	10-592055	39
22	394673	821	986202	54	408471	875	591529	38
23	395166	820	986169	54	408997	874	591003	37
24	395658	819	986137	54	409521	874	590479	36
25	396150	818	986104	54	410045	873	589955	35
26	396641	817	986072	54	410569	872	589431	34
27	397132	817	986039	54	411092	871	588908	33
28	397621	816	986007	54	411615	870	588385	32
29	398111	815	985974	54	412137	869	587863	31
30	398600	814	985942	54	412658	868	587342	30
31	9-399088	813	9-985909	55	9-413170	867	10-586821	29
32	399575	812	985876	55	413699	866	586301	28
33	400062	811	985843	55	414219	865	585781	27
34	400549	810	985811	55	414738	864	585262	26
35	401035	809	985778	55	415257	864	584743	25
36	401520	808	985745	55	415775	863	584225	24
37	402005	807	985712	55	416293	862	583707	23
38	402489	806	985679	55	416810	861	583190	22
39	402972	805	985646	55	417326	860	582674	21
40	403455	804	985613	55	417842	859	582158	20
41	9-403938	803	9-985580	55	9-418358	858	10-581642	19
42	404420	802	985547	55	418873	857	581127	18
43	404901	801	985514	55	419387	856	580613	17
44	405382	800	985480	55	419901	855	580099	16
45	405862	799	985447	55	420415	855	579585	15
46	406341	798	985414	56	420927	854	579073	14
47	406820	797	985380	56	421440	853	578560	13
48	407299	796	985347	56	421952	852	578048	12
49	407777	795	985314	56	422463	851	577537	11
50	408254	794	985280	56	422974	850	577026	10
51	9-408731	794	9-985247	56	9-423484	849	10-576516	9
52	409207	793	985213	56	423993	848	576007	8
53	409682	792	985180	56	424503	848	575497	7
54	410157	791	985146	56	425011	847	574989	6
55	410632	790	985113	56	425519	846	574481	5
56	411106	789	985079	56	426027	845	573973	4
57	411579	788	985045	56	426534	844	573466	3
58	412052	787	985011	56	427041	843	572959	2
59	412524	786	984978	56	427547	843	572453	1
60	412996	785	984944	56	428052	842	571948	0
	Cosine		Sine		Cotang.		Tang.	M.

75 Degrees.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9412996	785	9498494	57	9428052	842	10571948	60
1	413467	784	984910	57	428557	841	571443	59
2	413938	783	984876	57	429002	840	570938	58
3	414408	783	984842	57	429566	839	570434	57
4	414878	782	984808	57	430070	838	569930	56
5	415347	781	984774	57	430573	838	569427	55
6	415815	780	984740	57	431075	837	568925	54
7	416283	779	984706	57	431577	836	568423	53
8	416751	778	984672	57	432079	835	567921	52
9	417217	777	984637	57	432580	834	567420	51
10	417684	776	984603	57	433080	833	566920	50
11	9418150	775	9484569	57	9433580	832	10566490	49
12	418615	774	984535	57	434080	832	565920	48
13	419079	773	984500	57	434579	831	565421	47
14	419544	773	984466	57	435078	830	564922	46
15	420007	772	984432	58	435576	829	564424	45
16	420470	771	984397	58	436073	828	563927	44
17	420933	770	984363	58	436570	822	563430	43
18	421395	769	984328	58	437067	827	562933	42
19	421857	768	984294	58	437563	826	562437	41
20	422318	767	984259	58	438059	825	561941	40
21	9422778	767	9484224	58	9438554	824	10561446	39
22	423238	766	984190	58	439048	823	560952	38
23	423697	765	984155	58	439543	823	560457	37
24	424156	764	984120	58	440036	822	559964	36
25	424615	763	984085	58	440529	821	559471	35
26	425073	762	984050	58	441022	820	558978	34
27	425530	761	984015	58	441514	819	558486	33
28	425987	760	983981	58	442006	819	557994	32
29	426443	760	983946	58	442497	818	557503	31
30	426899	759	983911	58	442988	817	557012	30
31	9427354	758	9483875	58	9443473	816	10556521	29
32	427809	757	983840	59	443968	816	556032	28
33	428263	756	983805	59	444458	815	555542	27
34	428717	755	983770	59	444947	814	555053	26
35	429170	754	983735	59	445435	813	554565	25
36	429623	753	983700	59	445923	812	554077	24
37	430075	752	983664	59	446411	812	553589	23
38	430527	752	983629	59	446898	811	553102	22
39	430978	751	983594	59	447384	810	552616	21
40	431429	750	983558	59	447870	809	552130	20
41	9431879	749	9483523	59	9448356	809	10551644	19
42	432329	749	983487	59	448841	808	551159	18
43	432778	748	983452	59	449326	807	550674	17
44	433226	747	983416	59	449810	806	550190	16
45	433675	746	983381	59	450294	806	549706	15
46	434122	745	983345	59	450777	805	549223	14
47	434569	744	983309	59	451260	804	548740	13
48	435016	744	983273	60	451743	803	548257	12
49	435462	743	983238	60	452225	802	547775	11
50	435908	742	983202	60	452706	802	547294	10
51	9436353	741	9483166	60	9453187	801	10546813	9
52	436798	740	983130	60	453668	800	546332	8
53	437242	740	983094	60	454148	799	545852	7
54	437686	739	983058	60	454628	799	545372	6
55	438129	738	983022	60	455107	798	544893	5
56	438572	737	982986	60	455586	797	544414	4
57	439014	736	982950	60	456064	796	543936	3
58	439456	736	982914	60	456542	796	543458	2
59	439897	735	982878	60	457019	795	542981	1
60	440338	734	982842	60	457496	794	542504	0

Cosine Sine Cotang. Tang. M.

74 Degrees.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	M.
0	9440338	734	9982842	60	9457496	794	10542504	60
1	440778	733	982805	60	4579773	793	542027	59
2	441218	732	982769	61	458449	793	541551	58
3	441658	731	982733	61	458925	792	541075	57
4	442096	731	982696	61	459400	791	540600	56
5	442535	730	982660	61	459875	790	540125	55
6	442973	729	982624	61	460349	790	539651	54
7	443410	728	982587	61	460823	789	539177	53
8	443847	727	982551	61	461297	788	538703	52
9	444284	727	982514	61	461770	788	538230	51
10	444720	726	982477	61	462242	787	537758	50
11	9445155	725	9982441	61	9462714	786	10537286	49
12	445590	724	982404	61	463186	785	536814	48
13	446025	723	982367	61	463658	785	536342	47
14	446459	723	982331	61	464129	784	535871	46
15	446893	722	982294	61	464599	783	535401	45
16	447326	721	982257	61	465069	783	534931	44
17	447759	720	982220	62	465539	782	534461	43
18	448191	720	982183	62	466008	781	533992	42
19	448623	719	982146	62	466476	780	533524	41
20	449054	718	982109	62	466945	780	533055	40
21	9449485	717	9982072	62	9467413	779	10532587	39
22	449915	716	982035	62	467880	778	532120	38
23	450345	716	981998	62	468347	778	531653	37
24	450775	715	981961	62	468814	777	531186	36
25	451204	714	981924	62	469280	776	530720	35
26	451632	713	981886	62	469746	775	530254	34
27	452060	713	981849	62	470211	775	529789	33
28	452488	712	981812	62	470676	774	529324	32
29	452915	711	981774	62	471141	773	528859	31
30	453342	710	981737	62	471605	773	528395	30
31	9453768	710	9981690	63	9472068	772	10527932	29
32	454194	709	981662	63	472532	771	527468	28
33	454619	708	981625	63	472995	771	527005	27
34	455044	707	981587	63	473457	770	526543	26
35	455469	707	981549	63	473919	769	526081	25
36	455893	706	981512	63	474381	769	525619	24
37	456316	705	981474	63	474842	768	525158	23
38	456739	704	981436	63	475303	767	524697	22
39	457162	704	981399	63	475763	767	524237	21
40	457584	703	981361	63	476223	766	523777	20
41	9458006	702	9981323	63	9476683	765	10522317	19
42	458427	701	981285	63	477142	765	522858	18
43	458848	701	981247	63	477601	764	522399	17
44	459268	700	981209	63	478059	763	521941	16
45	459688	699	981171	63	478517	763	521483	15
46	460108	698	981133	64	478975	762	521025	14
47	460527	698	981095	64	479432	761	520568	13
48	460946	697	981057	64	479889	761	520111	12
49	461364	696	981019	64	480345	760	519655	11
50	461782	695	980981	64	480801	759	519199	10
51	9462199	695	9980942	64	9481257	759	10518743	9
52	462616	694	980904	64	481712	758	518288	8
53	463032	693	980866	64	482167	757	517833	7
54	463448	693	980827	64	482621	757	517379	6
55	463864	692	980789	64	483075	756	516925	5
56	464279	691	980750	64	483529	755	516471	4
57	464694	690	980712	64	483982	755	516018	3
58	465108	690	980673	64	484435	754	515565	2
59	465522	689	980635	64	484887	753	515113	1
60	465935	688	980596	64	485339	753	514661	0
	Cosine		Sine		Cotang.		Tang.	M.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9-465935	688	9-980506	64	9-485339	755	10-514661	60
1	466348	688	980558	04	485791	758	514909	59
2	466761	687	980519	65	486242	751	513758	58
3	467173	686	980480	65	486693	751	513307	57
4	467585	685	980442	65	487143	750	512857	56
5	467996	685	980403	65	487593	749	512407	55
6	468407	684	980364	65	488043	749	511957	54
7	468817	683	980325	65	488492	748	511508	53
8	469227	683	980286	65	488941	747	511059	52
9	469637	682	980247	65	489390	747	510610	51
10	470046	681	980208	65	489838	746	510162	50
11	9-470455	680	9-980169	65	9-490286	746	10-509714	49
12	470863	680	980130	65	490733	745	509267	48
13	471271	679	980091	65	491180	744	508820	47
14	471679	678	980052	65	491627	744	508373	46
15	472086	678	980012	65	492073	743	507927	45
16	472492	677	979973	65	492519	743	507481	44
17	472898	676	979934	66	492965	742	507035	43
18	473304	676	979895	66	493410	741	506590	42
19	473710	675	979855	66	493854	740	506146	41
20	474115	674	979816	66	494299	740	505701	40
21	9-474519	674	9-979776	66	9-494743	740	10-505257	39
22	474923	673	979737	66	495186	739	504814	38
23	475327	672	979697	66	495630	738	504370	37
24	475730	672	979658	66	496073	737	503927	36
25	476133	671	979618	66	496515	737	503485	35
26	476536	670	979579	66	496957	736	503043	34
27	476938	669	979539	66	497399	736	502601	33
28	477340	669	979499	66	497841	735	502159	32
29	477741	668	979459	66	498282	734	501718	31
30	478142	667	979420	66	498722	734	501278	30
31	9-478542	667	9-979380	66	9-499163	733	10-500837	29
32	478942	666	979340	66	499603	733	500397	28
33	479342	665	979300	67	500042	732	499958	27
34	479741	665	979260	67	500481	731	499519	26
35	480140	664	979220	67	500920	731	499080	25
36	480539	663	979180	67	501359	730	498641	24
37	480937	663	979140	67	501797	730	498203	23
38	481334	662	979100	67	502235	729	497765	22
39	481731	661	979059	67	502672	728	497328	21
40	482128	661	979019	67	503109	728	496891	20
41	9-482525	660	9-978979	67	9-503546	727	10-496454	19
42	482921	659	978939	67	503982	727	496018	18
43	483316	659	978898	67	504418	726	495582	17
44	483712	658	978858	67	504854	725	495146	16
45	484107	657	978817	67	505289	725	494711	15
46	484501	657	978777	67	505724	724	494276	14
47	484895	656	978736	67	506159	724	493841	13
48	485289	655	978696	68	506593	723	493407	12
49	485682	655	978655	68	507027	722	492973	11
50	486075	654	978615	68	507460	722	492540	10
51	9-486467	653	9-978574	68	9-507893	721	10-492107	9
52	486860	653	978533	68	508326	721	491674	8
53	487251	652	978493	68	508759	720	491241	7
54	487643	651	978452	68	509191	719	490809	6
55	488034	651	978411	68	509622	719	490378	5
56	488424	650	978370	68	510054	718	489946	4
57	488814	650	978329	68	510485	718	489515	3
58	489204	649	978288	68	510916	717	489084	2
59	489593	648	978247	68	511346	716	488654	1
60	489982	648	978206	68	511776	716	488224	0
	Cosine		Sine		Cotang.		Tang.	M.

72 Degrees.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9-480982	648	9-978206	68	9-511776	716	10-488224	60
1	490371	648	978165	68	512206	716	487794	59
2	490759	647	978124	68	512635	715	487365	58
3	491147	646	978083	69	513064	714	486936	57
4	491535	646	978042	69	513493	714	486507	56
5	491922	645	978001	69	513921	713	486079	55
6	492308	644	977959	69	514349	713	485651	54
7	492695	644	977918	69	514777	712	485223	53
8	493081	643	977877	69	515204	712	484796	52
9	493466	642	977835	69	515631	711	484369	51
10	493851	642	977794	69	516057	710	483943	50
11	9-494236	641	9-977752	69	9-516484	710	10-483516	49
12	494621	641	977711	69	516910	709	483090	48
13	495005	640	977669	69	517335	709	482665	47
14	495388	639	977628	69	517761	708	482239	46
15	495772	639	977586	69	518185	708	481815	45
16	496154	638	977544	70	518610	707	481390	44
17	496537	637	977503	70	519034	706	480966	43
18	496919	637	977461	70	519458	706	480542	42
19	497301	636	977419	70	519882	705	480118	41
20	497682	636	977377	70	520305	705	479695	40
21	9-498064	635	9-977335	70	9-520728	704	10-479272	39
22	498444	634	977293	70	521151	703	478849	38
23	498825	634	977251	70	521573	703	478427	37
24	499204	633	977209	70	521995	703	478005	36
25	499584	632	977167	70	522417	702	477583	35
26	499963	632	977125	70	522838	702	477162	34
27	500342	631	977083	70	523259	701	476741	33
28	500721	631	977041	70	523680	701	476320	32
29	501099	630	976999	70	524100	700	475900	31
30	501476	629	976957	70	524520	699	475480	30
31	9-501854	629	9-976914	70	9-524939	699	10-475061	29
32	502231	628	976872	71	525359	698	474641	28
33	502607	628	976830	71	525778	698	474222	27
34	502984	627	976787	71	526197	697	473803	26
35	503360	626	976745	71	526615	697	473385	25
36	503735	626	976702	71	527033	696	472967	24
37	504110	625	976660	71	527451	696	472549	23
38	504485	625	976617	71	527868	695	472132	22
39	504860	624	976574	71	528285	695	471715	21
40	505234	623	976532	71	528702	694	471298	20
41	9-505608	623	9-976489	71	9-529119	693	10-470881	19
42	505981	622	976446	71	529535	693	470465	18
43	506354	622	976404	71	529950	693	470050	17
44	506727	621	976361	71	530366	692	469634	16
45	507099	620	976318	71	530781	691	469219	15
46	507471	620	976275	71	531196	691	468804	14
47	507843	619	976232	72	531611	690	468389	13
48	508214	619	976189	72	532025	690	467975	12
49	508585	618	976146	72	532439	689	467561	11
50	508956	618	976103	72	532853	689	467147	10
51	9-509326	617	9-976060	72	9-533266	688	10-466734	9
52	509696	616	976017	72	533679	688	466321	8
53	510065	616	975974	72	534092	687	465908	7
54	510434	615	975930	72	534504	687	465496	6
55	510803	615	975887	72	534916	686	465084	5
56	511172	614	975844	72	535328	686	464672	4
57	511540	613	975800	72	535739	685	464261	3
58	511907	613	975757	72	536150	685	463850	2
59	512275	612	975714	72	536561	684	463439	1
60	512642	612	975670	72	536972	684	463028	0
	Cosine		Sine		Cotang.		Tang.	M.

71 Degrees.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9 512642	612	9 975670	73	9 538972	684	10 463028	00
1	513009	611	975627	73	537382	683	462618	50
2	513375	611	975583	73	537792	683	462208	52
3	513741	610	975539	73	538202	682	461798	57
4	514107	609	975496	73	538611	682	461389	56
5	514472	609	975452	73	539020	681	460980	55
6	514837	608	975408	73	539429	681	460571	54
7	515202	608	975365	73	539837	680	460163	53
8	515566	607	975321	73	540245	680	459755	52
9	515930	607	975277	73	540653	679	459347	51
10	516294	606	975233	73	541061	679	458939	50
11	9 516657	605	9 975189	73	9 541468	678	10 458532	49
12	517020	605	975145	73	541875	678	458125	48
13	517382	604	975101	73	542281	677	457719	47
14	517745	604	975057	73	542688	677	457312	46
15	518107	603	975013	73	543094	676	456906	45
16	518468	603	974969	74	543499	676	456501	44
17	518829	602	974925	74	543905	675	456095	43
18	519190	601	974880	74	544310	675	455690	42
19	519551	601	974836	74	544715	674	455285	41
20	519911	600	974792	74	545119	674	454881	40
21	9 520271	600	9 974748	74	9 545524	673	10 454476	39
22	520631	599	974703	74	545928	673	454072	38
23	520990	599	974659	74	546331	672	453669	37
24	521349	598	974614	74	546735	672	453265	36
25	521707	598	974570	74	547138	671	452862	35
26	522066	597	974525	74	547540	671	452460	34
27	522424	596	974481	74	547943	670	452057	33
28	522781	596	974436	74	548345	670	451655	32
29	523138	595	974391	74	548747	669	451253	31
30	523495	595	974347	75	549149	669	450851	30
31	9 523852	594	9 974302	75	9 549550	668	10 450450	29
32	524208	594	974257	75	549951	668	450049	28
33	524564	593	974212	75	550352	667	449648	27
34	524920	593	974167	75	550752	667	449248	26
35	525275	592	974122	75	551152	666	448848	25
36	525630	591	974077	75	551552	666	448448	24
37	525984	591	974032	75	551952	665	448048	23
38	526339	590	973987	75	552351	665	447649	22
39	526693	590	973942	75	552750	665	447250	21
40	527046	589	973897	75	553149	664	446851	20
41	9 527400	589	9 973852	75	9 553548	664	10 446452	19
42	527753	588	973807	75	553946	663	446054	18
43	528105	588	973761	75	554344	663	445656	17
44	528458	587	973716	76	554741	662	445259	16
45	528810	587	973671	76	555139	662	444861	15
46	529161	586	973625	76	555536	661	444464	14
47	529513	586	973580	76	555933	661	444067	13
48	529864	585	973535	76	556329	660	443671	12
49	530215	585	973489	76	556725	660	443275	11
50	530565	584	973444	76	557121	659	442879	10
51	9 530915	584	9 973398	76	9 557517	659	10 442483	9
52	531265	583	973352	76	557913	659	442087	8
53	531614	582	973307	76	558308	658	441692	7
54	531963	582	973261	76	558702	658	441296	6
55	532312	581	973215	76	559097	657	440903	5
56	532661	581	973169	76	559491	657	440509	4
57	533009	580	973124	76	559885	656	440115	3
58	533357	580	973078	76	560279	656	439721	2
59	533704	579	973032	77	560673	655	439327	1
60	534052	578	972986	77	561066	655	438934	0

Cosine Sine Cotang. Tang. M.

70 Degrees.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	M.
0	9-534052	578	9-972986	77	9-561066	655	10-438934	60
1	534399	577	972940	77	561459	654	438541	59
2	534745	577	972894	77	561851	654	438149	58
3	535092	577	972848	77	562244	653	437756	57
4	535438	576	972802	77	562636	653	437364	56
5	535783	576	972755	77	563028	653	436972	55
6	536129	575	972709	77	563419	652	436581	54
7	536474	574	972663	77	563811	652	436189	53
8	536818	574	972617	77	564202	651	435798	52
9	537163	573	972570	77	564592	651	435408	51
10	537507	573	972524	77	564983	650	435017	50
11	9-537851	572	9-972478	77	9-565373	650	10-434627	49
12	538194	572	972431	78	565763	649	434237	48
13	538538	571	972385	78	566153	649	433847	47
14	538880	571	972338	78	566542	649	433458	46
15	539223	570	972291	78	566932	648	433068	45
16	539565	570	972245	78	567320	648	432680	44
17	539907	569	972198	78	567709	647	432291	43
18	540249	569	972151	78	568098	647	431902	42
19	540590	568	972105	78	568486	646	431514	41
20	540931	568	972058	78	568873	646	431127	40
21	9-541272	567	9-972011	78	9-569261	645	10-430739	39
22	541613	567	971964	78	569648	645	430352	38
23	541953	566	971917	78	570035	645	429965	37
24	542293	566	971870	78	570422	644	429578	36
25	542632	565	971823	78	570809	644	429191	35
26	542971	565	971776	78	571195	643	428805	34
27	543310	564	971729	79	571581	643	428419	33
28	543649	564	971682	79	571967	642	428033	32
29	543987	563	971635	79	572352	642	427648	31
30	544325	563	971588	79	572738	642	427262	30
31	9-544663	562	9-971540	79	9-573123	641	10-426877	29
32	545000	562	971493	79	573507	641	426493	28
33	545338	561	971446	79	573892	640	426108	27
34	545674	561	971398	79	574276	640	425724	26
35	546011	560	971351	79	574660	639	425340	25
36	546347	560	971303	79	575044	639	424956	24
37	546683	559	971256	79	575427	639	424573	23
38	547019	559	971208	79	575810	638	424190	22
39	547354	558	971161	79	576193	638	423807	21
40	547689	558	971113	79	576576	637	423424	20
41	9-548024	557	9-971066	80	9-576958	637	10-423041	19
42	548359	557	971018	80	577341	636	422659	18
43	548693	556	970970	80	577723	636	422277	17
44	549027	556	970922	80	578104	636	421896	16
45	549360	555	970874	80	578486	635	421514	15
46	549693	555	970827	80	578867	635	421133	14
47	550026	554	970779	80	579248	634	420752	13
48	550359	554	970731	80	579629	634	420371	12
49	550692	553	970683	80	580009	634	419991	11
50	551024	553	970635	80	580389	633	419611	10
51	9-551356	552	9-970586	80	9-580769	633	10-419231	9
52	551687	552	970538	80	581149	632	418851	8
53	552018	552	970490	80	581528	632	418472	7
54	552349	551	970442	80	581907	632	418093	6
55	552680	551	970394	80	582286	631	417714	5
56	553010	550	970345	81	582665	631	417335	4
57	553341	550	970297	81	583043	630	416957	3
58	553670	549	970249	81	583422	630	416578	2
59	554000	549	970200	81	583800	629	416200	1
60	554329	548	970152	81	584177	629	415823	0
	Cosine		Sine		Cotang.		Tang.	M.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	M.
0	9-554399	548	9-970152	81	9-584177	029	10-415823	60
1	554658	548	970103	81	584555	029	415445	59
2	554987	547	970055	81	584932	028	415008	58
3	555315	547	970006	81	585309	028	414601	57
4	555643	546	969957	81	585686	027	414314	56
5	555971	546	969909	81	586062	027	413938	55
6	556299	545	969860	81	586439	027	413561	54
7	556626	545	969811	81	586815	026	413185	53
8	556953	544	969762	81	587190	026	412810	52
9	557280	544	969714	81	587566	025	412434	51
10	557606	543	969665	81	587941	025	412059	50
11	9-557932	543	9-969616	82	9-588316	025	10-411684	49
12	558258	543	969567	82	588691	024	411309	48
13	558583	542	969518	82	589066	024	410934	47
14	558909	542	969469	82	589440	023	410560	46
15	559234	541	969420	82	589814	023	410186	45
16	559558	541	969370	82	590188	023	409812	44
17	559883	540	969321	82	590562	022	409438	43
18	560207	540	969272	82	590935	022	409065	42
19	560531	539	969223	82	591308	022	408692	41
20	560855	539	969173	82	591681	021	408319	40
21	9-561178	538	9-969124	82	9-592054	021	10-407946	39
22	561501	538	969075	82	592428	020	407574	38
23	561824	537	969025	82	592798	020	407202	37
24	562146	537	968976	82	593170	019	406829	36
25	562468	536	968926	83	593542	019	406458	35
26	562790	536	968877	83	593914	018	406086	34
27	563112	536	968827	83	594285	018	405715	33
28	563433	535	968777	83	594656	018	405344	32
29	563755	535	968728	83	595027	017	404973	31
30	564075	534	968678	83	595398	017	404602	30
31	9-564396	534	9-968628	83	9-595768	017	10-404232	29
32	564716	533	968578	83	596138	016	403862	28
33	565036	533	968528	83	596508	016	403492	27
34	565356	532	968479	83	596878	016	403122	26
35	565676	532	968429	83	597247	015	402753	25
36	565995	531	968379	83	597616	015	402384	24
37	566314	531	968329	83	597985	015	402015	23
38	566632	531	968278	83	598354	014	401646	22
39	566951	530	968228	84	598722	014	401278	21
40	567269	530	968178	84	599091	013	400909	20
41	9-567587	529	9-968128	84	9-599459	013	10-400541	19
42	567904	529	968078	84	599827	013	400173	18
43	568222	528	968027	84	600194	012	399806	17
44	568539	528	967977	84	600562	012	399438	16
45	568856	528	967927	84	600929	011	399071	15
46	569172	527	967876	84	601296	011	398704	14
47	569488	527	967826	84	601662	011	398338	13
48	569804	526	967775	84	602029	010	397971	12
49	570120	526	967725	84	602395	010	397605	11
50	570435	525	967674	84	602761	010	397239	10
51	9-570751	525	9-967624	84	9-603127	009	10-396873	9
52	571066	524	967573	84	603493	009	396507	8
53	571380	524	967522	85	603858	009	396142	7
54	571695	523	967471	85	604223	008	395777	6
55	572009	523	967421	85	604588	008	395412	5
56	572323	523	967370	85	604953	007	395047	4
57	572636	522	967319	85	605317	007	394683	3
58	572950	522	967268	85	605682	007	394318	2
59	573263	521	967217	85	606046	006	393954	1
60	573575	521	967166	85	606410	006	393590	0
	Cosine		Sine		Cotang.		Tang.	M.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9-573575	521	9-967166	85	9-606410	606	10-393590	64
1	573888	520	967115	85	606773	606	393227	59
2	574200	520	967064	85	607137	605	392863	58
3	574512	519	967013	85	607500	605	392500	57
4	574824	519	966961	85	607863	604	392137	56
5	575136	519	966910	85	608225	604	391775	55
6	575447	518	966859	85	608588	604	391412	54
7	575758	518	966808	85	608950	603	391050	53
8	576069	517	966756	86	609312	603	390688	52
9	576379	517	966705	86	609674	603	390326	51
10	576689	516	966653	86	610036	602	389964	50
11	9-576999	516	9-966602	86	9-610397	602	10-389603	49
12	577309	516	966550	86	610759	602	389241	48
13	577618	515	966499	86	611120	601	388880	47
14	577927	515	966447	86	611480	601	388520	46
15	578236	514	966395	86	611841	601	388159	45
16	578545	514	966344	86	612201	600	387799	44
17	578853	513	966292	86	612561	600	387439	43
18	579162	513	966240	86	612921	600	387079	42
19	579470	513	966188	86	613281	599	386719	41
20	579777	512	966136	86	613641	599	386359	40
21	9-580085	512	9-966085	87	9-614000	598	10-386000	39
22	580392	511	966033	87	614359	598	385641	38
23	580699	511	965981	87	614718	598	385282	37
24	581005	511	965928	87	615077	597	384923	36
25	581312	510	965876	87	615435	597	384565	35
26	581618	510	965824	87	615793	597	384207	34
27	581924	509	965772	87	616151	596	383849	33
28	582229	509	965720	87	616509	596	383491	32
29	582535	509	965668	87	616867	596	383133	31
30	582840	508	965615	87	617224	595	382776	30
31	9-583145	508	9-965563	87	9-617582	595	10-382418	29
32	583449	507	965511	87	617939	595	382061	28
33	583754	507	965458	87	618295	594	381705	27
34	584058	506	965406	87	618652	594	381348	26
35	584361	506	965353	88	619008	594	380992	25
36	584665	506	965301	88	619364	593	380636	24
37	584968	505	965248	88	619721	593	380279	23
38	585272	505	965195	88	620076	593	379924	22
39	585574	504	965143	88	620432	592	379568	21
40	585877	504	965090	88	620787	592	379213	20
41	9-586179	503	9-965037	88	9-621142	592	10-378858	19
42	586482	503	964984	88	621497	591	378503	18
43	586783	503	964931	88	621852	591	378148	17
44	587085	502	964879	88	622207	590	377793	16
45	587386	502	964826	88	622561	590	377439	15
46	587688	501	964773	88	622915	590	377085	14
47	587989	501	964719	88	623269	589	376731	13
48	588290	501	964666	89	623623	589	376377	12
49	588590	500	964613	89	623976	589	376024	11
50	588890	500	964560	89	624330	588	375670	10
51	9-589190	499	9-964507	89	9-624683	588	10-375317	9
52	589489	499	964454	89	625036	588	374964	8
53	589789	499	964400	89	625388	587	374612	7
54	590088	498	964347	89	625741	587	374259	6
55	590387	498	964294	89	626093	587	373907	5
56	590686	497	964240	89	626445	586	373555	4
57	590984	497	964187	89	626797	586	373203	3
58	591282	497	964133	89	627149	586	372851	2
59	591580	496	964080	89	627501	585	372499	1
60	591878	496	964026	89	627852	585	372148	0
	Cosine		Sine		Cotang.		Tang.	

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9-591878	496	9-964096	89	9-627852	585	10-372148	60
1	592176	495	963972	89	628903	585	371797	59
2	592473	495	963919	89	628554	585	371446	58
3	592770	495	963865	90	628905	584	371095	57
4	593067	494	963811	90	629255	584	370745	56
5	593363	494	963757	90	629606	583	370394	55
6	593659	493	963704	90	629956	583	370044	54
7	593955	493	963650	90	630306	583	369694	53
8	594251	493	963596	90	630656	583	369344	52
9	594547	492	963542	90	631005	582	368995	51
10	594842	492	963488	90	631355	582	368645	50
11	9-595137	491	9-963434	90	9-631704	582	10-368296	49
12	595432	491	963379	90	632053	581	367947	48
13	595727	491	963325	90	632401	581	367597	47
14	596021	490	963271	90	632750	581	367250	46
15	596315	490	963217	90	633098	580	366902	45
16	596609	489	963163	90	633447	580	366553	44
17	596903	489	963108	91	633795	580	366205	43
18	597196	489	963054	91	634143	579	365857	42
19	597490	488	962999	91	634490	579	365510	41
20	597783	488	962945	91	634838	579	365162	40
21	9-598075	487	9-962890	91	9-635185	578	10-364815	39
22	598368	487	962836	91	635532	578	364468	38
23	598660	487	962781	91	635879	578	364121	37
24	598952	486	962727	91	636226	577	363774	36
25	599244	486	962672	91	636572	577	363428	35
26	599536	485	962617	91	636919	577	363081	34
27	599827	485	962562	91	637265	577	362735	33
28	600118	485	962508	91	637611	576	362389	32
29	600409	484	962453	91	637956	576	362044	31
30	600700	484	962398	92	638302	576	361698	30
31	9-600990	484	9-962343	92	9-638647	575	10-361353	29
32	601280	483	962288	92	638992	575	361008	28
33	601570	483	962233	92	639337	575	360663	27
34	601860	482	962178	92	639682	574	360318	26
35	602150	482	962123	92	640027	574	359973	25
36	602439	482	962067	92	640371	574	359629	24
37	602728	481	962012	92	640716	573	359284	23
38	603017	481	961957	92	641060	573	358940	22
39	603305	481	961902	92	641404	573	358596	21
40	603594	480	961846	92	641747	572	358253	20
41	9-603882	480	9-961791	92	9-642091	572	10-357909	19
42	604170	479	961735	92	642434	572	357566	18
43	604457	479	961680	92	642777	572	357223	17
44	604745	479	961624	93	643120	571	356880	16
45	605032	478	961569	93	643463	571	356537	15
46	605319	478	961513	93	643806	571	356194	14
47	605606	478	961458	93	644148	570	355852	13
48	605892	477	961402	93	644490	570	355510	12
49	606179	477	961346	93	644832	570	355168	11
50	606465	476	961290	93	645174	569	354826	10
51	9-606751	476	9-961235	93	9-645516	569	10-354484	9
52	607036	476	961179	93	645857	569	354143	8
53	607322	475	961123	93	646199	569	353801	7
54	607607	475	961067	93	646540	568	353460	6
55	607892	474	961011	93	646881	568	353119	5
56	608177	474	960955	93	647222	568	352778	4
57	608461	474	960899	93	647562	567	352438	3
58	608745	473	960843	94	647903	567	352097	2
59	609029	473	960786	94	648243	567	351757	1
60	609313	473	960730	94	648583	566	351417	0
	Cosine		Sine		Cotang.		Tang.	M.

66 Degrees.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	M.
0	9-609313	473	9-960730	94	9-648583	566	10-351417	60
1	609597	472	960674	94	648923	566	351077	59
2	609880	472	960618	94	649263	566	350737	58
3	610164	472	960561	94	649602	566	350398	57
4	610447	471	960505	94	649942	565	350058	56
5	610729	471	960448	94	650281	565	349719	55
6	611012	470	960392	94	650620	565	349380	54
7	611294	470	960335	94	650959	564	349041	53
8	611576	470	960279	94	651297	564	348703	52
9	611858	469	960222	94	651636	564	348364	51
10	612140	469	960165	94	651974	563	348026	50
11	9-612421	469	9-960109	95	9-652312	563	10-347688	49
12	612702	468	960052	95	652650	563	347350	48
13	612983	468	959995	95	652988	563	347012	47
14	613264	467	959938	95	653326	562	346674	46
15	613545	467	959882	95	653663	562	346337	45
16	613825	467	959825	95	654000	562	346000	44
17	614105	466	959768	95	654337	561	345663	43
18	614385	466	959711	95	654674	561	345326	42
19	614665	466	959654	95	655011	561	344989	41
20	614944	465	959596	95	655348	561	344652	40
21	9-615223	465	9-959539	95	9-655684	560	10-344316	39
22	615502	465	959482	95	656020	560	343980	38
23	615781	464	959425	95	656356	560	343644	37
24	616060	464	959368	95	656692	559	343308	36
25	616338	464	959310	96	657028	559	342973	35
26	616616	463	959253	96	657364	559	342636	34
27	616894	463	959195	96	657699	559	342301	33
28	617172	462	959138	96	658034	558	341966	32
29	617450	462	959081	96	658369	558	341631	31
30	617727	462	959023	96	658704	558	341296	30
31	9-618004	461	9-958965	96	9-659039	558	10-340961	29
32	618281	461	958908	96	659373	557	340627	28
33	618558	461	958850	96	659708	557	340292	27
34	618834	460	958792	96	660042	557	339958	26
35	619110	460	958734	96	660376	557	339624	25
36	619386	460	958677	96	660710	556	339290	24
37	619662	459	958619	96	661043	556	338957	23
38	619938	459	958561	96	661377	556	338623	22
39	620213	459	958503	97	661710	555	338290	21
40	620488	458	958445	97	662043	555	337957	20
41	9-620763	458	9-958387	97	9-662376	555	10-337624	19
42	621038	457	958329	97	662709	554	337291	18
43	621313	457	958271	97	663042	554	336958	17
44	621587	457	958213	97	663375	554	336625	16
45	621861	456	958154	97	663707	554	336293	15
46	622135	456	958096	97	664039	553	335961	14
47	622409	456	958038	97	664371	553	335629	13
48	622682	455	957979	97	664703	553	335297	12
49	622956	455	957921	97	665035	553	334965	11
50	623229	455	957863	97	665366	552	334634	10
51	9-623502	454	9-957804	97	9-665697	552	10-334303	9
52	623774	454	957746	98	666029	552	333971	8
53	624047	454	957687	98	666360	551	333640	7
54	624319	453	957628	98	666691	551	333309	6
55	624591	453	957570	98	667021	551	332979	5
56	624863	453	957511	98	667352	551	332648	4
57	625135	452	957452	98	667682	550	332318	3
58	625406	452	957393	98	668013	550	331987	2
59	625677	452	957335	98	668343	550	331657	1
60	625948	451	957276	98	668672	550	331328	0
	Cosine		Sine		Cotang.		Tang.	M.

65 Degrees.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	M.
0	9.625948	451	9.957276	98	9.668673	550	10.331327	60
1	626219	451	957217	98	669002	549	330998	59
2	626490	451	957158	98	669332	549	330668	58
3	626760	450	957099	98	669661	549	330339	57
4	627030	450	957040	98	669991	548	330009	56
5	627300	450	956981	98	670320	548	329680	55
6	627570	449	956921	99	670649	548	329351	54
7	627840	449	956862	99	670977	548	329023	53
8	628109	449	956803	99	671306	547	328694	52
9	628378	448	956744	99	671634	547	328366	51
10	628647	448	956684	99	671963	547	328037	50
11	9.628916	447	9.956625	99	9.672291	547	10.327709	49
12	629185	447	956566	99	672619	546	327381	48
13	629453	447	956506	99	672947	546	327053	47
14	629721	446	956447	99	673274	546	326726	46
15	629989	446	956387	99	673602	546	326398	45
16	630257	446	956327	99	673929	545	326071	44
17	630524	446	956268	99	674257	545	325743	43
18	630792	445	956208	100	674584	545	325416	42
19	631059	445	956148	100	674910	544	325090	41
20	631326	445	956089	100	675237	544	324763	40
21	9.631593	444	9.956029	100	9.675564	544	10.324436	39
22	631859	444	955969	100	675890	544	324410	38
23	632125	444	955909	100	676216	543	324084	37
24	632392	443	955849	100	676543	543	323757	36
25	632658	443	955789	100	676869	543	323431	35
26	632923	443	955729	100	677194	543	323106	34
27	633189	442	955669	100	677520	542	322780	33
28	633454	442	955609	100	677846	542	322454	32
29	633719	442	955548	100	678171	542	322129	31
30	633984	441	955488	100	678496	542	321804	30
31	9.634249	441	9.955428	101	9.678821	541	10.321179	29
32	634514	440	955368	101	679146	541	321654	28
33	634778	440	955307	101	679471	541	321329	27
34	635042	440	955247	101	679795	541	321005	26
35	635306	439	955186	101	680120	540	320680	25
36	635570	439	955126	101	680444	540	320356	24
37	635834	439	955065	101	680768	540	320032	23
38	636097	438	955005	101	681092	540	319708	22
39	636360	438	954944	101	681416	539	319384	21
40	636623	438	954883	101	681740	539	319060	20
41	9.636886	437	9.954823	101	9.682063	539	10.317937	19
42	637148	437	954762	101	682387	539	317613	18
43	637411	437	954701	101	682710	538	317290	17
44	637673	437	954640	101	683033	538	316967	16
45	637935	436	954579	101	683356	538	316644	15
46	638197	436	954518	102	683679	538	316321	14
47	638458	436	954457	102	684001	537	315999	13
48	638720	435	954396	102	684324	537	315676	12
49	638981	435	954335	102	684646	537	315354	11
50	639242	435	954274	102	684968	537	315032	10
51	9.639503	434	9.954213	102	9.685290	536	10.314710	9
52	639764	434	954152	102	685612	536	314388	8
53	640024	434	954090	102	685934	536	314066	7
54	640284	433	954029	102	686255	536	313745	6
55	640544	433	953968	102	686577	535	313423	5
56	640804	433	953906	102	686898	535	313102	4
57	641064	432	953845	102	687219	535	312781	3
58	641324	432	953783	102	687540	535	312460	2
59	641584	432	953722	103	687861	534	312139	1
60	641842	431	953660	103	688182	534	311818	0

| Cosine | | Sine | | Cotang. | | Tang. | | M.

64 Degrees.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	M.
0	9-641842	431	9-953660	102	9-688182	534	10-311818	60
1	642101	431	953599	103	688502	534	311498	59
2	642360	421	953537	103	688823	534	311177	58
3	642618	430	953475	103	689143	533	310857	57
4	642877	430	953413	103	689463	533	310537	56
5	643135	430	953352	103	689783	533	310217	55
6	643393	430	953290	103	690103	533	309897	54
7	643650	429	953228	103	690423	533	309577	53
8	643908	429	953166	103	690742	532	309258	52
9	644165	429	953104	103	691062	532	308938	51
10	644423	428	953042	103	691381	532	308619	50
11	9-644680	428	9-952980	104	9-691700	531	10-308300	49
12	644936	428	952918	104	692019	531	307981	48
13	645193	427	952855	104	692338	531	307662	47
14	645450	427	952793	104	692656	531	307344	46
15	645706	427	952731	104	692975	531	307025	45
16	645962	426	952669	104	693293	530	306707	44
17	646218	426	952606	104	693612	530	306388	43
18	646474	426	952544	104	693930	530	306070	42
19	646729	425	952481	104	694248	530	305752	41
20	646984	425	952419	104	694566	529	305434	40
21	9-647240	425	9-952356	104	9-694883	529	10-305117	39
22	647494	424	952294	104	695201	529	304799	38
23	647749	424	952231	104	695518	529	304482	37
24	648004	424	952168	105	695836	529	304164	36
25	648258	424	952106	105	696153	528	303847	35
26	648512	423	952043	105	696470	528	303530	34
27	648766	423	951980	105	696787	528	303213	33
28	649020	423	951917	105	697103	528	302897	32
29	649274	422	951854	105	697420	527	302580	31
30	649527	422	951791	105	697736	527	302264	30
31	9-649781	422	9-951728	105	9-698053	527	10-301947	29
32	650034	422	951665	105	698369	527	301631	28
33	650287	421	951602	105	698685	526	301315	27
34	650539	421	951539	105	699001	526	300999	26
35	650792	421	951476	105	699316	526	300684	25
36	651044	420	951412	105	699632	526	300368	24
37	651297	420	951349	106	699947	526	300053	23
38	651549	420	951286	106	700263	525	299737	22
39	651800	419	951222	106	700578	525	299422	21
40	652052	419	951159	106	700893	525	299107	20
41	9-652304	419	9-951096	106	9-701208	524	10-298792	19
42	652555	418	951032	106	701523	524	298477	18
43	652806	418	950968	106	701837	524	298163	17
44	653057	418	950905	106	702152	524	297848	16
45	653308	418	950841	106	702466	524	297534	15
46	653558	417	950778	106	702780	523	297220	14
47	653808	417	950714	106	703095	523	296905	13
48	654058	417	950650	106	703409	523	296591	12
49	654309	416	950586	106	703723	523	296277	11
50	654558	416	950522	107	704036	522	295964	10
51	654808	416	9-950458	107	9-704350	522	10-295650	9
52	655058	416	950394	107	704663	522	295337	8
53	655307	415	950330	107	704977	522	295023	7
54	655556	415	950266	107	705290	522	294710	6
55	655805	415	950202	107	705603	521	294397	5
56	656054	414	950138	107	705916	521	294084	4
57	656302	414	950074	107	706228	521	293772	3
58	656551	414	950010	107	706541	521	293459	2
59	656799	413	949945	107	706854	521	293146	1
60	657047	413	949881	107	707166	520	292834	0

	Cosine		Sine		Cotang.		Tang.		M.
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63 Degrees.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	M.
0	9-657047	413	9-949881	107	9-707166	520	10-292834	60
1	657295	413	949616	107	707478	520	292522	59
2	657542	412	949752	107	707790	520	292210	58
3	657790	412	949688	108	708102	520	291898	57
4	658037	412	949623	108	708414	519	291586	56
5	658284	412	949558	108	708726	519	291274	55
6	658531	411	949494	108	709037	519	290963	54
7	658778	411	949429	108	709349	519	290651	53
8	659025	411	949364	108	709660	519	290340	52
9	659271	410	949300	108	709971	518	290029	51
10	659517	410	949235	108	710282	518	289718	50
11	9-659763	410	9-949170	108	9-710583	518	10-289407	49
12	660009	409	949105	108	710904	518	289096	48
13	660255	409	949040	108	711215	518	288785	47
14	660501	409	948975	108	711525	517	288475	46
15	660746	409	948910	108	711836	517	288164	45
16	660991	408	948845	108	712146	517	287854	44
17	661236	408	948780	109	712456	517	287544	43
18	661481	408	948715	109	712766	516	287234	42
19	661726	407	948650	109	713076	516	286924	41
20	661970	407	948584	109	713386	516	286614	40
21	9-662214	407	9-948519	109	9-713696	516	10-286304	39
22	662459	407	948454	109	714005	516	285995	38
23	662703	406	948388	109	714314	515	285686	37
24	662946	406	948323	109	714624	515	285376	36
25	663190	406	948257	109	714933	515	285067	35
26	663433	405	948192	109	715242	515	284758	34
27	663677	405	948126	109	715551	514	284449	33
28	663920	405	948060	109	715860	514	284140	32
29	664163	405	947995	110	716168	514	283832	31
30	664406	404	947929	110	716477	514	283523	30
31	9-664648	404	9-947863	110	9-716785	514	10-283215	29
32	664891	404	947797	110	717093	513	282907	28
33	665133	403	947731	110	717401	513	282599	27
34	665375	403	947665	110	717709	513	282291	26
35	665617	403	947600	110	718017	513	281983	25
36	665859	402	947533	110	718325	513	281675	24
37	666100	402	947467	110	718633	512	281367	23
38	666342	402	947401	110	718940	512	281060	22
39	666583	402	947335	110	719248	512	280752	21
40	666824	401	947269	110	719555	512	280445	20
41	9-667065	401	9-947203	110	9-719862	512	10-280138	19
42	667305	401	947136	111	720169	511	279831	18
43	667546	401	947070	111	720476	511	279524	17
44	667786	400	947004	111	720783	511	279217	16
45	668027	400	946937	111	721089	511	278911	15
46	668267	400	946871	111	721396	511	278604	14
47	668506	399	946804	111	721702	510	278298	13
48	668746	399	946738	111	722009	510	277991	12
49	668986	399	946671	111	722315	510	277685	11
50	669225	399	946604	111	722621	510	277379	10
51	9-669464	398	9-946538	111	9-722927	510	10-277073	9
52	669703	398	946471	111	723232	509	276768	8
53	669942	398	946404	111	723538	509	276462	7
54	670181	397	946337	111	723844	509	276156	6
55	670419	397	946270	112	724149	509	275851	5
56	670658	397	946203	112	724454	509	275546	4
57	670896	397	946136	112	724759	508	275241	3
58	671134	396	946069	112	725065	508	274935	2
59	671372	396	946002	112	725369	508	274631	1
60	671609	396	945935	112	725674	508	274326	0

| Cosine | | Sine | | Cotang. | | Tang. | | M.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	M.
0	9-671609	396	9-945935	112	9-725674	508	10-274326	60
1	671847	395	945968	119	725979	508	274021	59
2	672084	395	945900	112	726284	507	273716	58
3	672321	395	945733	112	726588	507	273412	57
4	672558	395	945666	112	726892	507	273108	56
5	672795	394	945598	112	727197	507	272803	55
6	673032	394	945531	112	727501	507	272499	54
7	673268	394	945464	113	727805	506	272195	53
8	673505	394	945396	113	728109	506	271891	52
9	673741	393	945328	113	728412	506	271588	51
10	673977	393	945261	113	728716	506	271284	50
11	9-674213	393	9-945193	113	9-729090	506	10-270980	49
12	674448	392	945125	113	729323	505	270677	48
13	674684	392	945058	113	729626	505	270374	47
14	674919	392	944990	113	729929	505	270071	46
15	675155	392	944922	113	730233	505	269767	45
16	675390	391	944854	113	730535	505	269465	44
17	675624	391	944786	113	730838	504	269162	43
18	675859	391	944718	113	731141	504	268859	42
19	676094	391	944650	113	731444	504	268556	41
20	676328	390	944582	114	731746	504	268254	40
21	9-676562	390	9-944514	114	9-732048	504	10-267952	39
22	676796	390	944446	114	732351	503	267649	38
23	677030	390	944377	114	732653	503	267347	37
24	677264	389	944309	114	732955	503	267045	36
25	677498	389	944241	114	733257	503	266743	35
26	677731	389	944172	114	733558	503	266442	34
27	677964	388	944104	114	733860	502	266140	33
28	678197	388	944036	114	734162	502	265838	32
29	678430	388	943967	114	734463	502	265537	31
30	678663	388	943899	114	734764	502	265236	30
31	9-678895	387	9-943830	114	9-735066	502	10-264934	29
32	679128	387	943761	114	735367	502	264633	28
33	679360	387	943693	115	735668	501	264332	27
34	679592	387	943624	115	735969	501	264031	26
35	679824	386	943555	115	736269	501	263731	25
36	680056	386	943486	115	736570	501	263430	24
37	680288	386	943417	115	736871	501	263129	23
38	680519	385	943348	115	737171	500	262829	22
39	680750	385	943279	115	737471	500	262529	21
40	680982	385	943210	115	737771	500	262229	20
41	9-681213	385	9-943141	115	9-738071	500	10-261929	19
42	681443	384	943072	115	438371	500	261629	18
43	681674	384	943003	115	738671	499	261329	17
44	681905	384	942934	115	738971	499	261029	16
45	682135	384	942864	115	739271	499	260729	15
46	682365	383	942795	116	739570	499	260430	14
47	682595	383	942726	116	739870	499	260130	13
48	682825	383	942656	116	740169	499	259831	12
49	683055	383	942587	116	740468	498	259532	11
50	683284	382	942517	116	740767	498	259233	10
51	9-683514	382	9-942448	116	9-741066	498	10-258934	9
52	683743	382	942378	116	741365	498	258635	8
53	683972	382	942308	116	741664	498	258336	7
54	684201	381	942239	116	741962	497	258038	6
55	684430	381	942169	116	742261	497	257739	5
56	684658	381	942099	116	742559	497	257441	4
57	684887	380	942029	116	742858	497	257142	3
58	685115	380	941959	116	743156	497	256844	2
59	685343	380	941889	117	743454	497	256546	1
60	685571	380	941819	117	743752	496	256248	0
	Cosine		Sine		Cotang.		Tang.	M.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	M.
0	9-685571	380	9-941819	117	9-743759	496	10-256248	60
1	685799	379	941749	117	744050	496	255950	59
2	686027	379	941679	117	744348	496	255652	58
3	686254	379	941609	117	744645	496	255355	57
4	686482	379	941539	117	744943	496	255057	56
5	686709	378	941469	117	745240	496	254760	55
6	686936	378	941398	117	745538	495	254462	54
7	687163	378	941328	117	745835	495	254165	53
8	687390	378	941258	117	746132	495	253868	52
9	687616	377	941187	117	746429	495	253571	51
10	687843	377	941117	117	746726	495	253274	50
11	9-688069	377	9-941046	118	9-747023	494	10-252977	49
12	688295	377	940975	118	747319	494	252681	48
13	688521	376	940905	118	747616	494	252384	47
14	688747	376	940834	118	747913	494	252087	46
15	688972	376	940763	118	748209	494	251791	45
16	689198	376	940693	118	748505	493	251495	44
17	689423	375	940622	118	748801	493	251199	43
18	689648	375	940551	118	749097	493	250903	42
19	689873	375	940480	118	749393	493	250607	41
20	690098	375	940409	118	749689	493	250311	40
21	9-690323	374	9-940338	118	9-749985	493	10-250015	39
22	690548	374	940267	118	750281	492	249719	38
23	690772	374	940196	118	750576	492	249424	37
24	690996	374	940125	119	750872	492	249128	36
25	691220	373	940054	119	751167	492	248833	35
26	691444	373	939982	119	751462	492	248538	34
27	691668	373	939911	119	751757	492	248243	33
28	691892	373	939840	119	752052	491	247948	32
29	692115	372	939768	119	752347	491	247653	31
30	692339	372	939697	119	752642	491	247358	30
31	9-692562	372	9-939625	119	9-752937	491	10-247063	29
32	692785	371	939554	119	753231	491	246769	28
33	693008	371	939482	119	753526	491	246474	27
34	693231	371	939410	119	753820	490	246180	26
35	693453	371	939339	119	754115	490	245885	25
36	693676	370	939267	120	754409	490	245591	24
37	693898	370	939195	120	754703	490	245297	23
38	694120	370	939123	120	754997	490	245003	22
39	694342	370	939052	120	755291	490	244709	21
40	694564	369	938980	120	755585	489	244415	20
41	9-694786	369	9-938908	120	9-755878	489	10-244122	19
42	695007	369	938836	120	756172	489	243828	18
43	695229	369	938763	120	756465	489	243535	17
44	695450	368	938691	120	756759	489	243241	16
45	695671	368	938619	120	757052	489	242948	15
46	695892	368	938547	120	757345	488	242655	14
47	696113	368	938475	120	757638	488	242362	13
48	696334	367	938402	121	757931	488	242069	12
49	696554	367	938330	121	758224	488	241776	11
50	696775	367	938258	121	758517	488	241483	10
51	9-696995	367	9-938185	121	9-758810	488	10-241190	9
52	697215	366	938113	121	759102	487	240898	8
53	697435	366	938040	121	759395	487	240605	7
54	697654	366	937967	121	759687	487	240313	6
55	697874	366	937895	121	759979	487	240021	5
56	698094	365	937822	121	760272	487	239728	4
57	698313	365	937749	121	760564	487	239436	3
58	698532	365	937676	121	760856	486	239144	2
59	698751	365	937604	121	761148	486	238852	1
60	698970	364	937531	121	761439	486	238561	0
	Cosine		Sine		Cotang.		Tang.	M.

60 Degrees.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9-698970	364	9-937531	121	9-761439	486	10-238561	60
1	699189	364	937458	122	761731	486	238269	59
2	699407	364	937385	122	762023	486	237977	58
3	699626	364	937312	122	762314	486	237686	57
4	699844	363	937238	122	762606	485	237394	56
5	700062	363	937165	122	762897	485	237103	55
6	700280	363	937092	122	763188	485	236812	54
7	700498	363	937019	122	763479	485	236521	53
8	700716	363	936946	122	763770	485	236230	52
9	700933	362	936872	122	764061	485	235939	51
10	701151	362	936799	122	764352	484	235648	50
11	9-701368	362	9-936725	122	9-764643	484	10-235357	49
12	701585	362	936652	123	764933	484	235067	48
13	701802	361	936578	123	765224	484	234776	47
14	702019	361	936505	123	765514	484	234486	46
15	702236	361	936431	123	765805	484	234195	45
16	702452	361	936357	123	766095	484	233905	44
17	702669	360	936284	123	766385	483	233615	43
18	702885	360	936210	123	766675	483	233325	42
19	703101	360	936136	123	766965	483	233035	41
20	703317	360	936062	123	767255	483	232745	40
21	9-703533	359	9-935988	123	9-767545	483	10-232455	39
22	703749	359	935914	123	767834	483	232166	38
23	703964	359	935840	123	768124	482	231876	37
24	704179	359	935766	124	768413	482	231587	36
25	704395	359	935692	124	768703	482	231297	35
26	704610	358	935618	124	768992	482	231008	34
27	704825	358	935543	124	769281	482	230719	33
28	705040	358	935469	124	769570	482	230430	32
29	705254	358	935395	124	769860	481	230140	31
30	705469	357	935320	124	770148	481	229852	30
31	9-705683	357	9-935246	124	9-770437	481	10-229563	29
32	705898	357	935171	124	770726	481	229274	28
33	706112	357	935097	124	771015	481	228985	27
34	706326	356	935022	124	771303	481	228697	26
35	706539	356	934948	124	771592	481	228408	25
36	706753	356	934873	124	771880	480	228120	24
37	706967	356	934798	125	772168	480	227832	23
38	707180	355	934723	125	772457	480	227543	22
39	707393	355	934649	125	772745	480	227255	21
40	707606	355	934574	125	773033	480	226967	20
41	9-707819	355	9-934499	125	9-773321	480	10-226679	19
42	708032	354	934424	125	773608	479	226392	18
43	708245	354	934349	125	773896	479	226104	17
44	708458	354	934274	125	774184	479	225816	16
45	708670	354	934199	125	774471	479	225529	15
46	708882	353	934123	125	774759	479	225241	14
47	709094	353	934048	125	775046	479	224954	13
48	709306	353	933973	125	775333	478	224667	12
49	709518	353	933898	126	775621	478	224379	11
50	709730	353	933822	126	775908	478	224092	10
51	9-709941	352	9-933747	126	9-776195	478	10-223805	9
52	710153	352	933671	126	776482	478	223518	8
53	710364	352	933596	126	776769	478	223231	7
54	710575	352	933520	126	777055	478	222945	6
55	710786	351	933445	126	777342	478	222658	5
56	710997	351	933369	126	777628	477	222372	4
57	711208	351	933293	126	777915	477	222085	3
58	711419	351	933217	126	778201	477	221799	2
59	711629	350	933141	126	778487	477	221512	1
60	711839	350	933066	126	778774	477	221226	0
	Cosine		Sine		Cotang.		Tang.	M.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	M.
0	9-711839	350	9-933066	126	9-778774	477	10-221226	60
1	711950	350	932990	127	779060	477	220940	59
2	712260	350	932914	127	779346	476	220654	58
3	712460	349	932838	127	779632	476	220368	57
4	712679	349	932762	127	779918	476	220082	56
5	712899	349	932685	127	780203	476	219797	55
6	713098	349	932609	127	780489	476	219511	54
7	713308	349	932533	127	780775	476	219225	53
8	713517	348	932457	127	781060	476	218940	52
9	713726	348	932380	127	781346	475	218654	51
10	713935	348	932304	127	781631	475	218369	50
11	9-714144	348	9-932228	127	9-781916	475	10-218084	49
12	714352	347	932151	127	782201	475	217799	48
13	714561	347	932075	128	782486	475	217514	47
14	714769	347	931998	128	782771	475	217229	46
15	714978	347	931921	128	783056	475	216944	45
16	715186	347	931845	128	783341	475	216659	44
17	715394	346	931768	128	783626	474	216374	43
18	715602	346	931691	128	783910	474	216090	42
19	715809	346	931614	128	784195	474	215805	41
20	716017	346	931537	128	784479	474	215521	40
21	9-716224	345	9-931460	128	9-784764	474	10-215236	39
22	716432	345	931383	128	785048	474	214952	38
23	716639	345	931306	128	785332	473	214668	37
24	716846	345	931229	129	785616	473	214384	36
25	717053	345	931152	129	785900	473	214100	35
26	717259	344	931075	129	786184	473	213816	34
27	717466	344	930998	129	786468	473	213532	33
28	717673	344	930921	129	786752	473	213248	32
29	717879	344	930843	129	787036	473	212964	31
30	718085	343	930766	129	787319	472	212681	30
31	9-718291	343	9-930688	129	9-787603	472	10-212397	29
32	718497	343	930611	129	787886	472	212114	28
33	718703	343	930533	129	788170	472	211830	27
34	718909	343	930456	129	788453	472	211547	26
35	719114	342	930378	129	788736	472	211264	25
36	719320	342	930300	130	789019	472	210981	24
37	719525	342	930223	130	789302	471	210698	23
38	719730	342	930145	130	789585	471	210415	22
39	719935	341	930067	130	789868	471	210132	21
40	720140	341	929989	130	790151	471	209849	20
41	9-720345	341	9-929911	130	9-790433	471	10-209567	19
42	720549	341	929833	130	790716	471	209284	18
43	720754	340	929755	130	790999	471	209001	17
44	720958	340	929677	130	791281	471	208719	16
45	721162	340	929599	130	791563	470	208437	15
46	721366	340	929521	130	791846	470	208154	14
47	721570	340	929442	130	792128	470	207872	13
48	721774	339	929364	131	792410	470	207590	12
49	721978	339	929286	131	792692	470	207308	11
50	722181	339	929207	131	792974	470	207026	10
51	9-722385	339	9-929129	131	9-793256	470	10-206744	9
52	722588	339	929050	131	793538	469	206462	8
53	722791	338	928972	131	793819	469	206181	7
54	722994	338	928893	131	794101	469	205899	6
55	723197	338	928815	131	794383	469	205617	5
56	723400	338	928736	131	794664	469	205336	4
57	723603	337	928657	131	794945	469	205055	3
58	723805	337	928578	131	795227	469	204773	2
59	724007	337	928499	131	795508	468	204492	1
60	724210	337	928420	131	795789	468	204211	0
	Cosine		Sine		Cotang.		Tang.	M.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9724210	337	9928420	132	9795780	468	10204211	60
1	724412	337	928342	132	796070	468	203930	59
2	724614	336	928263	132	796351	468	203649	58
3	724816	336	928183	132	796632	468	203368	57
4	725017	336	928104	132	796913	468	203087	56
5	725219	336	928025	132	797194	468	202806	55
6	725420	335	927946	132	797475	468	202525	54
7	725622	335	927867	132	797755	468	202245	53
8	725823	335	927787	132	798036	467	201964	52
9	726024	335	927708	132	798316	467	201684	51
10	726225	335	927629	132	798596	467	201404	50
11	9726426	334	9927549	132	9796877	467	10201123	49
12	726826	334	927470	133	799157	467	200843	48
13	726827	334	927390	133	799437	467	200563	47
14	727027	334	927310	133	799717	467	200283	46
15	727228	334	927231	133	799997	466	200003	45
16	727428	333	927151	133	800277	466	199723	44
17	727628	333	927071	133	800557	466	199443	43
18	727828	333	926991	133	800836	466	199164	42
19	728027	333	926911	133	801116	466	198884	41
20	728227	333	926831	133	801396	466	198604	40
21	9728437	332	9926751	133	9801675	466	10198325	39
22	728626	332	926671	133	801955	466	198045	38
23	728625	332	926591	133	802234	465	197766	37
24	729024	332	926511	134	802513	465	197487	36
25	729223	331	926431	134	802792	465	197208	35
26	729422	331	926351	134	803072	465	196928	34
27	729621	331	926270	134	803351	465	196649	33
28	729820	331	926190	134	803630	465	196370	32
29	730018	330	926110	134	803908	465	196092	31
30	730216	330	926029	134	804187	465	195813	30
31	9730415	330	9925949	134	9804466	464	10195534	29
32	730613	330	925868	134	804745	464	195255	28
33	730811	330	925788	134	805023	464	194977	27
34	731009	329	925707	134	805302	464	194698	26
35	731206	329	925626	134	805580	464	194420	25
36	731404	329	925545	135	805859	464	194141	24
37	731602	329	925465	135	806137	464	193863	23
38	731799	329	925384	135	806415	463	193585	22
39	731996	328	925303	135	806693	463	193307	21
40	732193	328	925222	135	806971	463	193029	20
41	9732300	328	9925141	135	9807249	463	10192751	19
42	732537	328	925060	135	807527	463	192473	18
43	732784	328	924979	135	807805	463	192195	17
44	732980	327	924897	135	808083	463	191917	16
45	733177	327	924816	135	808361	463	191639	15
46	733373	327	924735	136	808638	462	191362	14
47	733569	327	924654	136	808916	462	191084	13
48	733765	327	924572	136	809193	462	190807	12
49	733961	326	924491	136	809471	462	190529	11
50	734157	326	924409	136	809748	462	190252	10
51	9734353	326	9924328	136	9810025	462	10189975	9
52	734549	326	924246	136	810302	462	189698	8
53	734744	325	924164	136	810580	462	189420	7
54	734939	325	924083	136	810857	462	189143	6
55	735135	325	924001	136	811134	461	188866	5
56	735330	325	923919	136	811410	461	188590	4
57	735525	325	923837	136	811687	461	188313	3
58	735719	324	923755	137	811964	461	188036	2
59	735914	324	923673	137	812241	461	187759	1
60	736109	324	923591	137	812517	461	187483	0

Cosine	Sine	Cotang.	Tang.	M.
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57 Degrees.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9-736109	324	9-923591	137	9-812517	461	10-187482	60
1	736303	324	923509	137	812794	461	187206	59
2	736498	324	923427	137	813070	461	186930	58
3	736692	323	923345	137	813347	460	186653	57
4	736886	323	923263	137	813623	460	186377	56
5	737080	323	923181	137	813899	460	186101	55
6	737274	323	923098	137	814175	460	185825	54
7	737467	323	923016	137	814452	460	185548	53
8	737661	322	922933	137	814728	460	185272	52
9	737855	322	922851	137	815004	460	184996	51
10	738048	322	922768	138	815279	460	184721	50
11	9-738241	322	9-922686	138	9-815555	459	10-184445	49
12	738434	322	922603	138	815831	459	184169	48
13	738627	321	922520	138	816107	459	183893	47
14	738820	321	922438	138	816382	459	183618	46
15	739013	321	922355	138	816658	459	183342	45
16	739206	321	922272	138	816933	459	183067	44
17	739398	321	922189	138	817209	459	182791	43
18	739590	320	922106	138	817484	459	182516	42
19	739783	320	922023	138	817759	459	182241	41
20	739975	320	921940	138	818035	458	181965	40
21	9-740167	320	9-921857	139	9-818310	458	10-181690	39
22	740359	320	921774	139	818585	458	181415	38
23	740550	319	921691	139	818860	458	181140	37
24	740742	319	921607	139	819135	458	180865	36
25	740934	319	921524	139	819410	458	180590	35
26	741125	319	921441	139	819684	458	180316	34
27	741316	319	921357	139	819959	458	180041	33
28	741508	318	921274	139	820234	458	179766	32
29	741699	318	921190	139	820508	457	179492	31
30	741890	318	921107	139	820783	457	179217	30
31	9-742080	318	9-921023	139	9-821057	457	10-178943	29
32	742271	318	920939	140	821332	457	178668	28
33	742462	317	920856	140	821606	457	178394	27
34	742652	317	920772	140	821880	457	178120	26
35	742842	317	920688	140	822154	457	177846	25
36	743033	317	920604	140	822429	457	177571	24
37	743223	317	920520	140	822703	457	177297	23
38	743413	316	920436	140	822977	456	177023	22
39	743602	316	920352	140	823250	456	176750	21
40	743792	316	920268	140	823524	456	176476	20
41	9-743982	316	9-920184	140	9-823798	456	10-176202	19
42	744171	316	920099	140	824072	456	175928	18
43	744361	315	920015	140	824345	456	175655	17
44	744550	315	919931	141	824619	456	175381	16
45	744739	315	919846	141	824893	456	175107	15
46	744928	315	919762	141	825166	456	174834	14
47	745117	315	919677	141	825439	455	174561	13
48	745306	314	919593	141	825713	455	174287	12
49	745494	314	919508	141	825986	455	174014	11
50	745683	314	919424	141	826259	455	173741	10
51	9-745871	314	9-919339	141	9-826532	455	10-173468	9
52	746059	314	919254	141	826805	455	173195	8
53	746248	313	919169	141	827078	455	172922	7
54	746436	313	919085	141	827351	455	172649	6
55	746624	313	919000	141	827624	455	172376	5
56	746812	313	918915	142	827897	454	172103	4
57	746999	313	918830	142	828170	454	171830	3
58	747187	312	918745	142	828442	454	171558	2
59	747374	312	918659	142	828715	454	171285	1
60	747562	312	918574	142	828987	454	171013	0
	Cosine		Sine		Cotang.		Tang.	M

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9-747562	312	9-918574	142	9-828867	454	10-171013	60
1	747749	312	918489	142	829260	454	170740	59
2	747936	312	918404	142	829532	454	170468	58
3	748123	311	918318	142	829805	454	170195	57
4	748310	311	918233	142	830077	454	169923	56
5	748497	311	918147	142	830349	453	169651	55
6	748683	311	918062	142	830621	453	169379	54
7	748870	311	917976	143	830893	453	169107	53
8	749056	310	917891	143	831165	453	168835	52
9	749243	310	917805	143	831437	453	168563	51
10	749429	310	917719	143	831709	453	168291	50
11	9-749615	310	9-917634	143	9-831981	453	10-168019	49
12	749801	310	917548	143	832253	453	167747	48
13	749987	309	917462	143	832525	453	167475	47
14	750172	309	917376	143	832796	453	167204	46
15	750358	309	917290	143	833068	452	166932	45
16	750543	309	917204	143	833339	452	166661	44
17	750729	309	917118	144	833611	452	166389	43
18	750914	308	917032	144	833882	452	166118	42
19	751099	308	916946	144	834154	452	165846	41
20	751284	308	916859	144	834425	452	165575	40
21	9-751469	308	9-916773	144	9-834696	452	10-165304	39
22	751654	308	916687	144	834967	452	165033	38
23	751839	308	916600	144	835238	452	164762	37
24	752023	307	916514	144	835509	452	164491	36
25	752208	307	916427	144	835780	451	164220	35
26	752392	307	916341	144	836051	451	163949	34
27	752576	307	916254	144	836322	451	163678	33
28	752760	307	916167	145	836593	451	163407	32
29	752944	306	916081	145	836864	451	163136	31
30	753128	306	915994	145	837134	451	162866	30
31	9-753312	306	9-915907	145	9-837405	451	10-162595	29
32	753495	306	915820	145	837675	451	162325	28
33	753679	306	915733	145	837946	451	162054	27
34	753862	305	915646	145	838216	451	161784	26
35	754046	305	915559	145	838487	450	161513	25
36	754229	305	915472	145	838757	450	161243	24
37	754412	305	915385	145	839027	450	160973	23
38	754595	305	915297	145	839297	450	160703	22
39	754778	304	915210	145	839568	450	160432	21
40	754960	304	915123	146	839838	450	160162	20
41	9-755143	304	9-915035	146	9-840108	450	10-159892	19
42	755326	304	914948	146	840378	450	159622	18
43	755508	304	914860	146	840647	450	159353	17
44	755690	304	914773	146	840917	449	159083	16
45	755872	303	914685	146	841187	449	158813	15
46	756054	303	914598	146	841457	449	158543	14
47	756236	303	914510	146	841726	449	158274	13
48	756418	303	914422	146	841996	449	158004	12
49	756600	303	914334	146	842266	449	157734	11
50	756782	302	914246	147	842535	449	157465	10
51	9-756963	302	9-914158	147	9-842805	449	10-157195	9
52	757144	302	914070	147	843074	449	156926	8
53	757326	302	913982	147	843343	449	156657	7
54	757507	302	913894	147	843612	449	156388	6
55	757688	301	913806	147	843882	448	156118	5
56	757869	301	913718	147	844151	448	155849	4
57	758050	301	913630	147	844420	448	155580	3
58	758230	301	913541	147	844689	448	155311	2
59	758411	301	913453	147	844958	448	155042	1
60	758591	301	913365	147	845227	448	154773	0
	Cosine.		Sine		Cotang.		Tang.	M.

55 Degrees.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9758591	301	9913365	147	9.845227	448	10-154773	60
1	758772	300	913276	147	845496	448	154504	59
2	758952	300	913187	148	845764	448	154236	58
3	759132	300	913099	148	846033	448	153967	57
4	759312	300	913010	148	846302	448	153698	56
5	759492	300	912922	148	846570	447	153430	55
6	759672	299	912833	148	846839	447	153161	54
7	759852	299	912744	148	847107	447	152893	53
8	760031	299	912655	148	847376	447	152624	52
9	760211	299	912566	148	847644	447	152356	51
10	760390	299	912477	148	847913	447	152087	50
11	9760569	298	9912388	148	9.848181	447	10-151819	49
12	760748	298	912299	149	848449	447	151551	48
13	760927	298	912210	149	848717	447	151283	47
14	761106	298	912121	149	848986	447	151014	46
15	761285	298	912031	149	849254	447	150746	45
16	761464	298	911942	149	849522	447	150478	44
17	761642	297	911853	149	849790	446	150210	43
18	761821	297	911763	149	850058	446	149942	42
19	761999	297	911674	149	850325	446	149675	41
20	762177	297	911584	149	850593	446	149407	40
21	9762356	297	9911495	149	9.850961	446	10-149139	39
22	762534	296	911405	149	851129	446	148871	38
23	762712	296	911315	150	851396	446	148604	37
24	762889	296	911226	150	851664	446	148336	36
25	763067	296	911136	150	851931	446	148069	35
26	763245	296	911046	150	852199	446	147801	34
27	763422	296	910956	150	852466	446	147534	33
28	763600	295	910866	150	852733	445	147267	32
29	763777	295	910776	150	853001	445	146999	31
30	763954	295	910686	150	853268	445	146732	30
31	9764131	295	9910596	150	9.853535	445	10-146465	29
32	764308	295	910506	150	853802	445	146198	28
33	764485	294	910415	150	854069	445	145931	27
34	764662	294	910325	151	854336	445	145664	26
35	764838	294	910235	151	854603	445	145397	25
36	765015	294	910144	151	854870	445	145130	24
37	765191	294	910054	151	855137	445	144863	23
38	765367	294	909963	151	855404	445	144596	22
39	765544	293	909873	151	855671	444	144329	21
40	765720	293	909782	151	855938	444	144062	20
41	9765896	293	9909691	151	9.856204	444	10-143796	19
42	766072	293	909601	151	856471	444	143529	18
43	766247	293	909510	151	856737	444	143263	17
44	766423	293	909419	151	857004	444	142996	16
45	766598	292	909328	152	857270	444	142730	15
46	766774	292	909237	152	857537	444	142463	14
47	766949	292	909146	152	857803	444	142197	13
48	767124	292	909055	152	858069	444	141931	12
49	767300	292	908964	152	858336	444	141664	11
50	767475	291	908873	152	858602	443	141398	10
51	9767649	291	9908781	152	9.858868	443	10-141132	9
52	767824	291	908690	152	859134	443	140866	8
53	767999	291	908599	152	859400	443	140600	7
54	768173	291	908507	152	859666	443	140334	6
55	768348	290	908416	153	859932	443	140068	5
56	768522	290	908324	153	860198	443	139802	4
57	768697	290	908233	153	860464	443	139536	3
58	768871	290	908141	153	860730	443	139270	2
59	769045	290	908049	153	860995	443	139005	1
60	769219	290	907958	153	861261	443	138739	0
	Cosine		Sine		Cotang.		Tang.	M.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9769219	290	9907958	153	9861261	443	10138739	40
1	769393	289	907866	153	861527	443	138473	59
2	769566	289	907774	153	861792	442	138208	58
3	769740	289	907682	153	862058	442	137942	57
4	769913	289	907590	153	862323	442	137677	56
5	770087	289	907498	153	862589	442	137411	55
6	770260	288	907406	153	862854	442	137146	54
7	770433	288	907314	154	863119	442	136881	53
8	770606	288	907222	154	863385	442	136615	52
9	770779	288	907129	154	863650	442	136350	51
10	770952	288	907037	154	863915	442	136085	50
11	977125	288	9906945	154	9864180	442	10135820	49
12	771298	287	906852	154	864445	442	135555	48
13	771470	287	906760	154	864710	442	135290	47
14	771643	287	906667	154	864975	441	135025	46
15	771815	287	906575	154	865240	441	134760	45
16	771987	287	906482	154	865505	441	134495	44
17	772159	287	906389	155	865770	441	134230	43
18	772331	286	906296	155	866035	441	133965	42
19	772503	286	906204	155	866300	441	133700	41
20	772675	286	906111	155	866564	441	133436	40
21	9772847	286	9906018	155	9866829	441	10133171	39
22	773018	286	905925	155	867094	441	132906	38
23	773190	286	905832	155	967358	441	132642	37
24	773361	285	905739	155	867623	441	132377	36
25	773533	285	905645	155	867887	441	132113	35
26	773704	285	905552	155	868152	440	131848	34
27	773875	285	905459	155	868416	440	131584	33
28	774046	285	905366	156	868680	440	131320	32
29	774217	285	905272	156	868945	440	131055	31
30	774388	284	905179	156	869209	440	130791	30
31	9774558	284	9905085	156	9869473	440	10130527	29
32	774729	284	904992	156	869737	440	130203	28
33	774899	284	904898	156	870001	440	129999	27
34	775070	284	904804	156	870265	440	129735	26
35	775240	284	904711	156	870529	440	129471	25
36	775410	283	904617	156	870793	440	129207	24
37	775580	283	904523	156	871057	440	128943	23
38	775750	283	904429	157	871321	440	128679	22
39	775920	283	904335	157	871585	440	128415	21
40	776090	283	904241	157	871849	439	128151	20
41	9776250	283	9904147	157	9872112	439	10127888	19
42	776429	282	904053	157	872376	439	127624	18
43	776598	282	903959	157	872640	439	127360	17
44	776768	282	903864	157	872903	439	127097	16
45	776937	282	903770	157	873167	439	126833	15
46	777106	282	903676	157	873430	439	126570	14
47	777275	281	903581	157	873694	439	126306	13
48	777444	281	903487	157	873957	439	126043	12
49	777613	281	903392	158	874220	439	125780	11
50	777781	281	903298	158	874484	439	125516	10
51	9777950	281	9903203	158	9874747	439	10125253	9
52	778119	281	903108	158	875010	439	124990	8
53	778287	280	903014	158	875273	438	124727	7
54	778455	280	902919	158	875536	438	124464	6
55	778624	280	902824	158	875800	438	124200	5
56	778792	280	902729	158	876063	438	123937	4
57	778960	280	902634	158	876326	438	123674	3
58	779128	280	902539	159	876589	438	123411	2
59	779295	279	902444	159	876851	438	123149	1
60	779463	279	902349	159	877114	438	122886	0
	Cosine		Sine		Cotang.		Tang.	M.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	M.
0	9-779463	279	9-902349	150	9-877114	438	10-122886	60
1	779631	279	902253	150	877377	438	122823	59
2	779798	279	902158	150	877640	438	122860	58
3	779966	279	902063	150	877903	438	122907	57
4	780133	279	901967	150	878165	438	121835	56
5	780300	278	901872	150	878428	438	121572	55
6	780467	278	901776	150	878691	438	121309	54
7	780634	278	901681	150	878953	437	121047	53
8	780801	278	901585	150	879216	437	120784	52
9	780968	278	901490	150	879478	437	120522	51
10	781134	278	901394	160	879741	437	120259	50
11	9-781301	277	9-901298	160	9-880003	437	10-119997	49
12	781468	277	901202	160	880265	437	119735	48
13	781634	277	901106	160	880528	437	119472	47
14	781800	277	901010	160	880790	437	119210	46
15	781966	277	900914	160	881052	437	118948	45
16	782132	277	900818	160	881314	437	118686	44
17	782298	276	900722	160	881576	437	118424	43
18	782464	276	900626	160	881839	437	118161	42
19	782630	276	900529	160	882101	437	117899	41
20	782796	276	900433	161	882363	436	117637	40
21	9-782961	276	9-900337	161	9-882625	436	10-117375	39
22	783127	276	900240	161	882887	436	117113	38
23	783292	275	900144	161	883148	436	116852	37
24	783458	275	900047	161	883410	436	116590	36
25	783623	275	899951	161	883672	436	116328	35
26	783788	275	899854	161	883934	436	116066	34
27	783953	275	899757	161	884196	436	115804	33
28	784118	275	899660	161	884457	436	115543	32
29	784282	274	899564	161	884719	436	115281	31
30	784447	274	899467	162	884980	436	115020	30
31	9-784612	274	9-899370	162	9-885242	436	10-114758	29
32	784776	274	899273	162	885503	436	114497	28
33	784941	274	899176	162	885765	436	114235	27
34	785105	274	899078	162	886026	436	113974	26
35	785269	273	898981	162	886288	436	113712	25
36	785433	273	898884	162	886549	435	113451	24
37	785597	273	898787	162	886810	435	113190	23
38	785761	273	898689	162	887072	435	112928	22
39	785925	273	898592	162	887333	435	112667	21
40	786089	273	898494	163	887594	435	112406	20
41	9-786252	272	9-898397	163	9-887855	435	10-112145	19
42	786416	272	898299	163	888116	435	111884	18
43	786579	272	898202	163	888377	435	111623	17
44	786742	272	898104	163	888639	435	111361	16
45	786906	272	898006	163	888900	435	111100	15
46	787069	272	897908	163	889160	435	110840	14
47	787232	271	897810	163	889421	435	110579	13
48	787395	271	897712	163	889682	435	110318	12
49	787557	271	897614	163	889943	435	110057	11
50	787720	271	897516	163	890204	434	109796	10
51	9-787883	271	9-897418	164	9-890465	434	10-109535	9
52	788045	271	897320	164	890725	434	109275	8
53	788208	271	897222	164	890986	434	109014	7
54	788370	270	897123	164	891247	434	108753	6
55	788532	270	897025	164	891507	434	108493	5
56	788694	270	896926	164	891768	434	108232	4
57	788856	270	896828	164	892028	434	107972	3
58	789018	270	896729	164	892289	434	107711	2
59	789180	270	896631	164	892549	434	107451	1
60	789342	269	896532	164	892810	434	107190	0

	Cosine		Sine		Cotang.		Tang.		M.
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M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9789342	269	9896532	164	9892810	434	10107190	60
1	799504	269	896433	165	893070	434	106930	59
2	799665	269	896335	165	893331	434	106669	58
3	799827	269	896236	165	893591	434	106409	57
4	799988	269	896137	165	893851	434	106149	56
5	790149	269	896038	165	894111	434	105889	55
6	790310	268	895939	165	894371	434	105629	54
7	790471	268	895840	165	894632	433	105368	53
8	790632	268	895741	165	894892	433	105108	52
9	790793	268	895641	165	895152	433	104848	51
10	790954	268	895542	165	895412	433	104588	50
11	9791115	268	9895443	166	9895672	433	10104328	49
12	791275	267	895343	166	895932	433	104068	48
13	791436	267	895244	166	896192	433	103808	47
14	791596	267	895145	166	896452	433	103548	46
15	791757	267	895045	166	896712	433	103288	45
16	791917	267	894945	166	896971	433	103029	44
17	792077	267	894846	166	897231	433	102769	43
18	792237	266	894746	166	897491	433	102509	42
19	792397	266	894646	166	897751	433	102249	41
20	792557	266	894546	166	898010	433	101990	40
21	9792716	266	9894446	167	9898270	433	10101730	39
22	792876	266	894346	167	898530	433	101470	38
23	793035	266	894246	167	898789	433	101211	37
24	793195	265	894146	167	899049	432	100951	36
25	793354	265	894046	167	899308	432	100692	35
26	793514	265	893946	167	899568	432	100432	34
27	793673	265	893846	167	899827	432	100173	33
28	793832	265	893745	167	900086	432	099914	32
29	793991	265	893645	167	900346	432	099654	31
30	794150	264	893544	167	900605	432	099395	30
31	9794308	264	9893444	168	9900864	432	10099136	29
32	794467	264	893343	168	901124	432	098876	28
33	794626	264	893243	168	901383	432	098617	27
34	794784	264	893142	168	901642	432	098358	26
35	794942	264	893041	168	901901	432	098099	25
36	795101	264	892940	168	902160	432	097840	24
37	795259	264	892839	168	902419	432	097581	23
38	795417	263	892739	168	902679	432	097321	22
39	795575	263	892638	168	902938	432	097062	21
40	795733	263	892536	168	903197	431	096803	20
41	9795891	263	9892435	169	9903455	431	10096545	19
42	796049	263	892334	169	903714	431	096286	18
43	796206	263	892233	169	903973	431	096027	17
44	796364	262	892132	169	904232	431	095768	16
45	796521	262	892030	169	904491	431	095509	15
46	796679	262	891929	169	904750	431	095250	14
47	796836	262	891827	169	905008	431	094992	13
48	796993	262	891726	169	905267	431	094733	12
49	797150	261	891624	169	905526	431	094474	11
50	797307	261	891523	170	905784	431	094216	10
51	9797464	261	9891421	170	9906043	431	10093957	9
52	797621	261	891319	170	906302	431	093698	8
53	797777	261	891217	170	906560	431	093440	7
54	797934	261	891115	170	906819	431	093181	6
55	798091	261	891013	170	907077	431	092923	5
56	798247	261	890911	170	907336	431	092664	4
57	798403	260	890809	170	907594	431	092406	3
58	798560	260	890707	170	907852	431	092148	2
59	798716	260	890605	170	908111	430	091889	1
60	798872	260	890503	170	908369	430	091631	0
	Cosine		Sine		Cotang.		Tang.	M.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9798872	260	9890503	170	9008369	430	10091631	60
1	799028	260	890400	171	908628	430	091372	59
2	799184	260	890298	171	908886	430	091114	58
3	799339	259	890195	171	909144	430	090856	57
4	799495	259	890093	171	909402	430	090598	56
5	799651	259	889990	171	909660	430	090340	55
6	799806	259	889888	171	909918	430	090082	54
7	799962	259	889785	171	910177	430	089823	53
8	800117	259	889682	171	910435	430	089565	52
9	800272	258	889579	171	910693	430	089307	51
10	800427	258	889477	171	910951	430	089049	50
11	9800582	258	9889374	172	9911209	430	10088791	49
12	800737	258	889271	172	911467	430	088533	48
13	800892	258	889168	172	911724	430	088276	47
14	801047	258	889064	172	911982	430	088018	46
15	801201	258	888961	172	912240	430	087760	45
16	801356	257	888858	172	912498	430	087502	44
17	801511	257	888755	172	912756	430	087244	43
18	801665	257	888651	172	913014	429	086986	42
19	801819	257	888548	172	913271	429	086729	41
20	801973	257	888444	173	913529	429	086471	40
21	9802128	257	9888341	173	9913787	429	10086213	39
22	802282	256	888237	173	914044	429	085956	38
23	802436	256	888134	173	914302	429	085698	37
24	802589	256	888030	173	914560	429	085440	36
25	802743	256	887926	173	914817	429	085183	35
26	802897	256	887822	173	915075	429	084925	34
27	803050	256	887718	173	915332	429	084668	33
28	803204	256	887614	173	915590	429	084410	32
29	803357	255	887510	173	915847	429	084153	31
30	803511	255	887406	174	916104	429	083896	30
31	9803664	255	9887302	174	9916362	429	10083638	29
32	803817	255	887198	174	916619	429	083381	28
33	803970	255	887093	174	916877	429	083123	27
34	804123	255	886989	174	917134	429	082866	26
35	804276	254	886885	174	917391	429	082609	25
36	804428	254	886780	174	917648	429	082352	24
37	804581	254	886676	174	917905	429	082095	23
38	804734	254	886571	174	918163	428	081837	22
39	804886	254	886466	174	918420	428	081580	21
40	805039	254	886362	175	918677	428	081323	20
41	9805191	254	9886257	175	9918934	428	10081066	19
42	805343	253	886152	175	919191	428	080819	18
43	805495	253	886047	175	919448	428	080552	17
44	805647	253	885942	175	919705	428	080295	16
45	805799	253	885837	175	919962	428	080038	15
46	805951	253	885732	175	920219	428	079781	14
47	806103	253	885627	175	920476	428	079524	13
48	806254	253	885522	175	920733	428	079267	12
49	806406	252	885416	175	920990	428	079010	11
50	806557	252	885311	176	921247	428	078753	10
51	9806709	252	9885205	176	9921503	428	10078497	9
52	806860	252	885100	176	921760	428	078240	8
53	807011	252	884994	176	922017	428	077983	7
54	807163	252	884889	176	922274	428	077726	6
55	807314	252	884783	176	922530	428	077470	5
56	807465	251	884677	176	922787	428	077213	4
57	807615	251	884572	176	923044	428	076956	3
58	807766	251	884466	176	923300	428	076700	2
59	807917	251	884360	176	923557	427	076443	1
60	808067	251	884254	177	923813	427	076187	0

Cosine

Sine

Cotang.

Tang.

M.

50 Degrees.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9-808067	251	9-884254	177	9-923813	427	10-076187	60
1	808218	251	884148	177	924070	427	075930	59
2	808368	251	884042	177	924327	427	075673	58
3	808519	250	883936	177	924583	427	075417	57
4	808669	250	883829	177	924840	427	075160	56
5	808819	250	883723	177	925096	427	074904	55
6	808969	250	883617	177	925352	427	074648	54
7	809119	250	883510	177	925609	427	074391	53
8	809269	250	883404	177	925865	427	074135	52
9	809419	249	883297	178	926122	427	073878	51
10	809569	249	883191	178	926378	427	073622	50
11	9-809718	249	9-883084	178	9-926634	427	10-073366	49
12	809868	249	882977	178	926890	427	073110	48
13	810017	249	882871	178	927147	427	072853	47
14	810167	249	882764	178	927403	427	072597	46
15	810316	248	882657	178	927659	427	072341	45
16	810465	248	882550	178	927916	427	072085	44
17	810614	248	882443	178	928171	427	071829	43
18	810763	248	882336	179	928427	427	071573	42
19	810912	248	882229	179	928683	427	071317	41
20	811061	248	882121	179	928940	427	071060	40
21	9-811210	248	9-882014	179	9-929196	427	10-070804	39
22	811358	247	881907	179	929452	427	070548	38
23	811507	247	881799	179	929708	427	070292	37
24	811655	247	881692	179	929964	426	070036	36
25	811804	247	881584	179	930220	426	069780	35
26	811952	247	881477	179	930475	426	069525	34
27	812100	247	881369	179	930731	426	069269	33
28	812248	247	881261	180	930987	426	069013	32
29	812396	246	881153	180	931243	426	068757	31
30	812544	246	881046	180	931499	426	068501	30
31	9-812692	246	9-880938	180	9-931755	426	10-068245	29
32	812840	246	880830	180	932010	426	067990	28
33	812988	246	880722	180	932266	426	067734	27
34	813135	246	880613	180	932522	426	067478	26
35	813283	246	880505	180	932778	426	067222	25
36	813430	245	880397	180	933033	426	066967	24
37	813578	245	880289	181	933289	426	066711	23
38	813725	245	880180	181	933545	426	066455	22
39	813872	245	880072	181	933800	426	066200	21
40	814019	245	879963	181	934056	426	065944	20
41	9-814166	245	9-879855	181	9-934311	426	10-065689	19
42	814313	245	879746	181	934567	426	065433	18
43	814460	244	879637	181	934823	426	065177	17
44	814607	244	879529	181	935078	426	064922	16
45	814753	244	879420	181	935333	426	064667	15
46	814900	244	879311	181	935589	426	064411	14
47	815046	244	879202	182	935844	426	064156	13
48	815193	244	879093	182	936100	426	063900	12
49	815339	244	878984	182	936355	426	063645	11
50	815485	243	878875	182	936610	426	063390	10
51	9-815631	243	9-878766	182	9-936866	425	10-063134	9
52	815778	243	878656	182	937121	425	062879	8
53	815924	243	878547	182	937376	425	062624	7
54	816069	243	878438	182	937632	425	062368	6
55	816215	243	878328	182	937887	425	062113	5
56	816361	243	878219	183	938142	425	061858	4
57	816507	242	878109	183	938398	425	061602	3
58	816652	242	877999	183	938653	425	061347	2
59	816798	242	877890	183	938908	425	061092	1
60	816943	242	877780	183	939163	425	060837	0
	Sine		Sine		Cotang.		Tang.	M.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	M.
0	9-816943	242	9-877780	183	9-939163	425	10-060637	60
1	817088	242	877670	183	939418	425	060582	59
2	817233	242	877560	183	939673	425	060327	58
3	817379	242	877450	183	939928	425	060072	57
4	817524	241	877340	183	940183	425	059817	56
5	817668	241	877230	184	940438	425	059562	55
6	817813	241	877120	184	940694	425	059306	54
7	817958	241	877010	184	940949	425	059051	53
8	818103	241	876899	184	941204	425	058796	52
9	818247	241	876789	184	941458	425	058542	51
10	818392	241	876678	184	941714	425	058286	50
11	9-818536	240	9-876568	184	9-941968	425	10-058032	49
12	818681	240	876457	184	942223	425	057777	48
13	818825	240	876347	184	942478	425	057522	47
14	818969	240	876236	185	942733	425	057267	46
15	819113	240	876125	185	942988	425	057012	45
16	819257	240	876014	185	943243	425	056757	44
17	819401	240	875904	185	943498	425	056502	43
18	819545	239	875793	185	943752	425	056248	42
19	819689	239	875682	185	944007	425	055993	41
20	819832	239	875571	185	944262	425	055738	40
21	9-819976	239	9-875459	185	9-944517	425	10-055483	39
22	820120	239	875348	185	944771	424	055229	38
23	820263	239	875237	185	945026	424	054974	37
24	820406	239	875126	186	945281	424	054719	36
25	820550	238	875014	186	945535	424	054465	35
26	820693	238	874903	186	945790	424	054210	34
27	820836	238	874791	186	946045	424	053955	33
28	820979	238	874680	186	946299	424	053701	32
29	821122	238	874568	186	946554	424	053446	31
30	821265	238	874456	186	946808	424	053192	30
31	9-821407	238	9-874344	186	9-947063	424	10-052937	29
32	821550	238	874232	187	947318	424	052682	28
33	821693	237	874121	187	947572	424	052428	27
34	821835	237	874009	187	947826	424	052174	26
35	821977	237	873896	187	948081	424	051919	25
36	822120	237	873784	187	948336	424	051664	24
37	822262	237	873672	187	948590	424	051410	23
38	822404	237	873560	187	948844	424	051156	22
39	822546	237	873448	187	949099	424	050901	21
40	822688	236	873335	187	949353	424	050647	20
41	9-822830	236	9-873223	187	9-949607	424	10-050393	19
42	822972	236	873110	188	949862	424	050138	18
43	823114	236	872998	188	950116	424	049884	17
44	823255	236	872885	188	950370	424	049630	16
45	823397	236	872772	188	950625	424	049375	15
46	823539	236	872659	188	950879	424	049121	14
47	823680	235	872547	188	951133	424	048867	13
48	823821	235	872434	188	951388	424	048612	12
49	823963	235	872321	188	951642	424	048358	11
50	824104	235	872208	188	951896	424	048104	10
51	9-824245	235	9-872095	189	9-952150	424	10-047850	9
52	824386	235	871981	189	952405	424	047595	8
53	824527	235	871868	189	952659	424	047341	7
54	824668	234	871755	189	952913	424	047087	6
55	824808	234	871641	189	953167	423	046833	5
56	824949	234	871528	189	953421	423	046579	4
57	825090	234	871414	189	953675	423	046325	3
58	825230	234	871301	189	953929	423	046071	2
59	825371	234	871187	189	954183	423	045817	1
60	825511	234	871073	190	954437	423	045563	0

| Cosine | Sine | Cotang. | Tang. | M.

48 Degrees.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	M.
0	9825511	234	9871073	190	9854437	423	10045563	60
1	825651	233	870860	190	954691	423	045009	59
2	825791	233	870846	190	954945	423	045055	58
3	825931	233	870732	190	955200	423	044800	57
4	826071	233	870618	190	955454	423	044546	56
5	826211	233	870504	190	955707	423	044293	55
6	826351	232	870390	190	955961	423	044039	54
7	826491	233	870276	190	956215	423	043785	53
8	826631	233	870161	190	956469	423	043531	52
9	826770	232	870047	191	956723	423	043277	51
10	826910	232	869933	191	956977	423	043023	50
11	9827049	232	9869818	191	9857231	423	10042769	49
12	827189	232	869704	191	957485	423	042515	48
13	827328	232	869589	191	957739	423	042261	47
14	827467	232	869474	191	957993	423	042007	46
15	827606	232	869360	191	958246	423	041754	45
16	827745	232	869245	191	958500	423	041500	44
17	827884	231	869130	191	958754	423	041246	43
18	828023	231	869015	192	959008	423	040992	42
19	828162	231	868900	192	959262	423	040738	41
20	828301	231	868785	192	959516	423	040484	40
21	9828439	231	9868670	192	9859769	423	10040231	39
22	828578	231	868555	192	960023	423	039977	38
23	828716	231	868440	192	960277	423	039723	37
24	828855	230	868324	192	960531	423	039469	36
25	828993	230	868209	192	960784	423	039216	35
26	829131	230	868093	192	961038	423	038962	34
27	829269	230	867978	193	961291	423	038709	33
28	829407	230	867862	193	961545	423	038455	32
29	829545	230	867747	193	961799	423	038201	31
30	829683	230	867631	193	962052	423	037948	30
31	9829821	229	9867515	193	9862306	423	10037694	29
32	829959	229	867399	193	962580	423	037440	28
33	830097	229	867283	193	962813	423	037187	27
34	830234	229	867167	193	963067	423	036933	26
35	830372	229	867051	193	963320	423	036680	25
36	830509	229	866935	194	963574	423	036426	24
37	830646	229	866819	194	963827	423	036173	23
38	830784	229	866703	194	964081	423	035919	22
39	830921	228	866586	194	964335	423	035665	21
40	831058	228	866470	194	964588	422	035412	20
41	9831195	228	9866353	194	9864842	422	10035158	19
42	831332	228	866237	194	965095	422	034905	18
43	831469	228	866120	194	965349	422	034651	17
44	831606	228	866004	195	965602	422	034398	16
45	831742	228	865887	195	965855	422	034145	15
46	831879	228	865770	195	966109	422	033891	14
47	832015	227	865653	195	966362	422	033638	13
48	832152	227	865536	195	966616	422	033384	12
49	832288	227	865419	195	966869	422	033131	11
50	832425	227	865302	195	967123	422	032877	10
51	9832561	227	9865185	195	9867376	422	10032624	9
52	832697	227	865068	195	967629	422	032371	8
53	832833	227	864950	195	967883	422	032117	7
54	832969	226	864833	196	968136	422	031864	6
55	833105	226	864716	196	968389	422	031611	5
56	833241	226	864598	196	968643	422	031357	4
57	833377	226	864481	196	968896	422	031104	3
58	833512	226	864363	196	969149	422	030851	2
59	833648	226	864245	196	969403	422	030597	1
60	833783	226	864127	196	969656	422	030344	0
	Cosine		Sine		Cotang.		Tang.	M.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9-833783	226	9-864127	196	9-960656	422	10-030344	60
1	833919	225	864010	196	960909	422	030091	59
2	834054	225	863892	197	970162	422	029838	58
3	834189	225	863774	197	970416	422	029584	57
4	834325	225	863656	197	970669	422	029331	56
5	834460	225	863538	197	970922	422	029078	55
6	834595	225	863419	197	971175	422	028825	54
7	834730	225	863301	197	971429	422	028571	53
8	834865	225	863183	197	971682	422	028318	52
9	834999	224	863064	197	971935	422	028065	51
10	835134	224	862946	198	972188	422	027812	50
11	9-835269	224	9-862827	198	9-972441	422	10-027559	49
12	835403	224	862709	198	972694	422	027306	48
13	835538	224	862590	198	972948	422	027052	47
14	835672	224	862471	198	973201	422	026799	46
15	835807	224	862353	198	973454	422	026546	45
16	835941	224	862234	198	973707	422	026293	44
17	836075	223	862115	198	973960	422	026040	43
18	836209	223	861996	198	974213	422	025787	42
19	836343	223	861877	198	974466	422	025534	41
20	836477	223	861758	199	974719	422	025281	40
21	9-836611	223	9-861638	199	9-974973	422	10-025027	39
22	836745	223	861519	199	975226	422	024774	38
23	836878	223	861400	199	975479	422	024521	37
24	837012	222	861280	199	975732	422	024268	36
25	837146	222	861161	199	975985	422	024015	35
26	837279	222	861041	199	976238	422	023762	34
27	837412	222	860922	199	976491	422	023509	33
28	837546	222	860802	199	976744	422	023256	32
29	837679	222	860682	200	976997	422	023003	31
30	837812	222	860562	200	977250	422	022750	30
31	9-837945	222	9-860442	200	9-977503	422	10-022497	29
32	838078	221	860322	200	977756	422	022244	28
33	838211	221	860202	200	978009	422	021991	27
34	838344	221	860082	200	978262	422	021738	26
35	838477	221	859962	200	978515	422	021485	25
36	838610	221	859842	200	978768	422	021232	24
37	838742	221	859721	201	979021	422	020979	23
38	838875	221	859601	201	979274	422	020726	22
39	839007	221	859480	201	979527	422	020473	21
40	839140	220	859360	201	979780	422	020220	20
41	9-839272	220	9-859239	201	9-980033	422	10-019967	19
42	839404	220	859119	201	980286	422	019714	18
43	839536	220	858998	201	980538	422	019462	17
44	839668	220	858877	201	980791	421	019209	16
45	839800	220	858756	202	981044	421	018956	15
46	839932	220	858635	202	981297	421	018703	14
47	840064	219	858514	202	981550	421	018450	13
48	840196	219	858393	202	981803	421	018197	12
49	840328	219	858272	202	982056	421	017944	11
50	840459	219	858151	202	982309	421	017691	10
51	9-840591	219	9-858029	202	9-982562	421	10-017438	9
52	840722	219	857908	202	982814	421	017186	8
53	840854	219	857786	202	983067	421	016933	7
54	840985	219	857665	203	983320	421	016680	6
55	841116	218	857543	203	983573	421	016427	5
56	841247	218	857422	203	983826	421	016174	4
57	841378	218	857300	203	984079	421	015921	3
58	841509	218	857178	203	984331	421	015669	2
59	841640	218	857056	203	984584	421	015416	1
60	841771	218	856934	203	984837	421	015163	0

Cosine | Sine | Cotang. | Tang. | M.

M.	Sine	D.	Cosine	D.	Tang.	D.	Cotang.	
0	9841771	218	9856934	203	9984837	421	10-015163	60
1	841902	218	856812	203	985090	421	014910	59
2	842033	218	856690	204	985343	421	014657	58
3	842163	217	856568	204	985596	421	014404	57
4	842294	217	856446	204	985848	421	014152	56
5	842424	217	856323	204	986101	421	013899	55
6	842555	217	856201	204	986354	421	013646	54
7	842685	217	856078	204	986607	421	013393	53
8	842815	217	855956	204	986860	421	013140	52
9	842946	217	855833	204	987112	421	012888	51
10	843076	217	855711	205	987365	421	012635	50
11	9843206	216	9855588	205	9987618	421	10-012382	49
12	843336	216	855465	205	987871	421	012129	48
13	843466	216	855342	205	988123	421	011877	47
14	843595	216	855219	205	988376	421	011624	46
15	843725	216	855096	205	988629	421	011371	45
16	843855	216	854973	205	988882	421	011118	44
17	843984	216	854850	205	989134	421	010866	43
18	844114	215	854727	206	989387	421	010613	42
19	844243	215	854603	206	989640	421	010360	41
20	844372	215	854480	206	989893	421	010107	40
21	9844502	215	9854356	206	9990145	421	10-009855	39
22	844631	215	854233	206	990398	421	009602	38
23	844760	215	854109	206	990651	421	009349	37
24	844889	215	853986	206	990903	421	009097	36
25	845018	215	853862	206	991156	421	008844	35
26	845147	215	853738	206	991409	421	008591	34
27	845276	214	853614	207	991662	421	008338	33
28	845405	214	853490	207	991914	421	008086	32
29	845533	214	853366	207	992167	421	007833	31
30	845662	214	853242	207	992420	421	007580	30
31	9845790	214	9853118	207	9992672	421	10-007328	29
32	845919	214	852994	207	992925	421	007075	28
33	846047	214	852869	207	993178	421	006822	27
34	846175	214	852745	207	993430	421	006570	26
35	846304	214	852620	207	993683	421	006317	25
36	846432	213	852496	208	993936	421	006064	24
37	846560	213	852371	208	994189	421	005811	23
38	846688	213	852247	208	994441	421	005559	22
39	846816	213	852122	208	994694	421	005306	21
40	846944	213	851997	208	994947	421	005053	20
41	9847071	213	9851872	208	9995199	421	10-004801	19
42	847199	213	851747	208	995452	421	004548	18
43	847327	213	851622	208	995705	421	004295	17
44	847454	212	851497	209	995957	421	004043	16
45	847582	212	851372	209	996210	421	003790	15
46	847709	212	851246	209	996463	421	003537	14
47	847836	212	851121	209	996715	421	003285	13
48	847964	212	850996	209	996968	421	003032	12
49	848091	212	850870	209	997221	421	002779	11
50	848218	212	850745	209	997473	421	002527	10
51	9848345	212	9850619	209	9997726	421	10-002274	9
52	848472	211	850493	210	997979	421	002021	8
53	848599	211	850368	210	998231	421	001769	7
54	848726	211	850242	210	998484	421	001516	6
55	848852	211	850116	210	998737	421	001263	5
56	848979	211	849990	210	998989	421	001011	4
57	849106	211	849864	210	999242	421	000758	3
58	849232	211	849738	210	999495	421	000505	2
59	849359	211	849611	210	999748	421	000253	1
60	849485	211	849485	210	10-000000	421	000000	0
	Cosine		Sine		Cotang.		Tang.	M.

TABLE XXIX.
NATURAL SIGNS AND TANGENTS.

°	0°	1°	2°	3°	4°	5°	6°	7°	°
0	000 0000	017 4524	034 8995	052 3360	069 7565	087 1557	104 5285	121 8693	60
1	2909	7432	035 1902	6264	070 0467	4455	8178	122 1581	59
2	5818	018 0341	4809	9169	3368	7353	105 1070	4168	58
3	8727	3249	7716	053 2074	6270	088 0251	3963	7355	57
4	001 1636	6158	036 0623	4979	9171	3148	6856	123 0241	56
5	4544	9068	3530	7883	071 2073	6046	9748	3128	55
6	7453	019 1974	6437	054 0788	4974	8943	106 2641	6015	54
7	002 0362	4883	9344	3693	7876	089 1840	5533	8901	53
8	3271	7791	037 2251	6597	072 0777	4738	8425	124 1788	52
9	6180	020 0699	5158	9502	3678	7635	107 1318	4674	51
10	9089	3608	8065	055 2406	6580	090 0532	4210	7560	50
11	003 1998	6516	038 0971	5311	9481	3429	7102	125 0446	49
12	4907	9424	3878	8215	073 2382	6326	9994	3332	48
13	7815	021 2332	6785	056 1119	5283	9223	108 2885	6218	47
14	004 0724	5241	9692	4024	8184	091 2119	5777	9104	46
15	3633	8149	039 2598	6928	074 1085	5016	8669	126 1990	45
16	6542	022 1057	5505	9832	3986	7913	109 1560	4875	44
17	9451	3965	8411	057 2736	6887	092 0809	4452	7761	43
18	005 2300	6873	040 1318	5640	9787	3706	7343	127 0646	42
19	5268	9781	4224	8544	075 2688	6602	110 0234	3531	41
20	8177	023 2690	7131	058 1448	5589	9499	3126	6410	40
21	003 1086	5598	041 0037	4352	8489	093 2395	6017	9302	39
22	3995	8506	2944	7256	076 1390	5291	8908	128 2186	38
23	6904	024 1414	5850	059 0160	4290	8187	111 1799	5071	37
24	9813	4322	8757	3064	7190	094 1083	4689	7956	36
25	007 2721	7230	042 1663	5967	077 0091	3979	7580	129 0841	35
26	5630	025 0138	4569	8871	2991	6875	112 0471	3725	34
27	8539	3046	7475	060 1775	5891	9771	3361	6609	33
28	008 1448	5954	043 0382	4678	8791	095 2666	6252	9494	32
29	4357	8862	3288	7582	078 1091	5562	9142	130 2378	31
30	7265	086 1769	6194	061 0485	4591	8458	113 2032	5262	30
31	009 0174	4677	9100	3389	7491	096 1353	4922	8146	29
32	3083	7685	044 2006	6292	079 0391	4248	7812	131 1030	28
33	5992	027 0493	4912	9196	3290	7144	114 0702	3913	27
34	8900	3401	7818	062 2099	6190	097 0039	3592	6797	26
35	010 1809	6309	045 0724	5002	9030	2934	6482	9681	25
36	4718	9216	3630	7905	080 1989	5829	9372	132 2564	24
37	7627	028 2124	6536	063 0808	4889	8724	115 2261	5447	23
38	011 0535	5032	9442	3711	7788	098 1619	5151	8330	22
39	3444	7940	046 2347	6614	081 0687	4514	8040	133 1213	21
40	6353	029 0847	5253	9517	3587	7408	116 0929	4096	20
41	9261	3755	8159	064 2420	6486	099 0303	3818	6979	19
42	012 2170	6662	047 1065	5323	9385	3197	6707	9862	18
43	5079	9570	3970	8226	082 2284	6092	9596	134 2744	17
44	7987	030 2478	6876	065 1129	5183	8986	117 2485	5627	16
45	013 0896	5385	9781	4031	8082	100 1881	5374	8509	15
46	3805	8293	048 2687	6934	083 0981	4775	8263	135 1392	14
47	6713	031 1200	5592	9836	3880	7669	118 1151	4274	13
48	9622	4108	8498	066 2739	6778	101 0563	4040	7156	12
49	014 2530	7015	049 1403	5641	9677	3457	6928	136 0038	11
50	5439	9922	4308	8544	084 2576	6351	9816	2919	10
51	8348	032 2830	7214	067 1446	5474	9245	119 2704	5801	9
52	015 1256	5737	050 0119	4349	8373	102 2138	5593	8683	8
53	4165	8644	3024	7251	085 1271	5032	8481	137 1564	7
54	7073	033 1552	5929	068 0153	4169	7925	120 1368	4445	6
55	9982	4459	8835	3055	7067	103 0819	4256	7327	5
56	016 2890	7366	051 1740	5957	9966	3712	7144	138 0208	4
57	5799	034 0274	4645	8859	086 2864	6605	123 0031	3089	3
58	8707	3181	7550	069 1761	5762	9499	2919	5970	2
59	017 1616	6088	052 0455	4663	8660	104 2392	5806	8850	1
60	4524	8996	3360	7565	087 1557	5285	8693	139 1731	0
°	89°	88°	87°	86°	85°	84°	83°	82°	°

NAT. COSINE.

	8°	9°	10°	11°	12°	13°	14°	15°	
0	139 1731	156 4345	173 6482	190 8090	207 9117	224 9511	241 9219	258 8190	60
1	4612	7218	9346	191 0945	208 1962	225 2345	242 2041	259 1000	59
2	7492	157 0091	174 2211	3801	4807	5179	4863	3810	58
3	140 0372	2963	5075	6656	7652	8013	7685	6619	57
4	3252	5836	7939	9510	209 0497	226 0846	243 0507	9428	56
5	6132	8708	175 0803	192 2365	3341	3680	3329	260 2237	55
6	9012	158 1581	3667	5220	6186	6513	6150	5045	54
7	141 1892	4453	6531	8074	9030	9346	8971	7853	53
8	4772	7325	9395	193 0928	210 1874	227 2179	244 1792	261 0682	52
9	7651	159 0197	176 2258	3782	4718	5012	4613	3469	51
10	142 0531	3069	5121	6636	7561	7844	7433	6277	50
11	3410	5940	7984	9490	211 0405	228 0677	245 0254	9085	49
12	6289	8812	177 0847	194 2344	3248	3509	3074	262 1892	48
13	9168	160 1683	3710	5197	6091	6341	5894	4699	47
14	143 2047	4555	6573	8050	8934	9172	8713	7506	46
15	4926	7426	9435	195 0903	212 1777	229 2004	246 1533	263 0312	45
16	7805	161 0297	178 2298	3756	4619	4835	4352	3118	44
17	144 0684	3167	5160	6609	7462	7666	7171	5925	43
18	3562	6038	8022	9461	213 0304	230 0497	9990	8730	42
19	6440	8909	179 0884	196 2314	3146	3328	247 2809	264 1536	41
20	9319	162 1779	3746	5166	5988	6159	5627	4342	40
21	145 2197	4650	6607	8018	8829	8989	8445	7147	39
22	5075	7520	9469	197 0870	214 1671	231 1819	248 1263	9952	38
23	7953	163 0390	180 2330	3722	4512	4649	4081	265 2757	37
24	146 0830	3260	5191	6573	7353	7479	6899	5561	36
25	3708	6129	8052	9425	215 0194	232 0309	9716	8366	35
26	6585	8999	181 0913	198 2276	3035	3138	249 2533	266 1170	34
27	9463	164 1868	3774	5127	5876	5967	5350	3973	33
28	147 2340	4738	6635	7978	8716	8796	8167	6777	32
29	5217	7607	9495	199 0829	216 1556	233 1625	250 0984	9581	31
30	8094	165 0476	182 2355	3679	4396	4454	3800	267 2384	30
31	148 0971	3345	5215	6530	7236	7282	6616	5187	29
32	3848	6214	8075	9380	217 0076	234 0110	9432	7989	28
33	6724	9082	183 0935	200 2230	2915	2938	251 2248	268 0792	27
34	9601	166 1951	3795	5080	5754	5766	5063	3594	26
35	149 2477	4819	6654	7930	8593	8594	7879	6396	25
36	5353	7687	9514	201 0779	218 1432	235 1421	252 0694	9198	24
37	8230	167 0556	184 2373	3629	4271	4248	3508	269 2000	23
38	150 1106	3423	5232	6478	7110	7075	6323	4801	22
39	3981	6291	8091	9327	9948	9902	9137	7602	21
40	6857	9159	185 0949	202 2176	219 2786	236 2729	253 1952	270 0403	20
41	9733	168 2026	3808	5024	5624	5555	4766	3204	19
42	151 2608	4894	6666	7873	8462	8381	7579	6004	18
43	5484	7761	9524	203 0721	220 1300	237 1207	254 0393	8805	17
44	8359	169 0628	186 2382	3569	4137	4033	3206	271 1605	16
45	152 1234	3495	5240	6418	6974	6859	6019	4404	15
46	4109	6362	8098	9265	9811	9684	8832	7204	14
47	6984	9228	187 0956	204 2113	221 2648	238 2510	255 1645	272 0003	13
48	9858	170 2095	3813	4961	5485	5335	4458	2802	12
49	153 2733	4961	6670	7808	8321	8159	7270	5601	11
50	5607	7828	9528	205 0655	222 1158	239 0984	256 0082	8400	10
51	8482	171 0694	188 2385	3502	3994	3808	2894	273 1198	9
52	154 1356	3560	5241	6349	6830	6633	5705	3997	8
53	4230	6425	8098	9195	9666	9457	8517	6794	7
54	7104	9291	189 0954	206 2042	223 2501	240 2280	257 1328	9592	6
55	9978	172 2156	3811	4888	5337	5104	4139	274 2390	5
56	155 2851	5022	6667	7734	8172	7927	6950	5187	4
57	5725	7887	9523	207 0580	224 1007	241 0751	9760	7984	3
58	8598	173 0752	190 2379	3426	3842	3574	258 2570	275 0781	2
59	156 1472	3617	5234	6272	6676	6396	5381	3577	1
60	4345	6482	8090	9117	9511	9219	8190	6374	0
	81°	80°	79°	78°	77°	76°	75°	74°	

/	16°	17°	18°	19°	20°	21°	22°	23°	/
0	.275 6374	.292 3717	.309 0170	.325 5682	.342 0201	.358 3679	.374 6066	.390 7311	00
1	9170	6499	2936	8432	2935	6395	8763	9989	59
2	.276 1965	9280	5702	.326 1182	5668	9110	.375 1459	.391 2666	58
3	4761	.293 2061	8468	3932	8400	.359 1825	4156	5343	57
4	7556	4842	.310 1234	6681	.343 1133	4540	6852	8019	56
5	.277 0352	7623	3999	9430	3865	7254	9547	.392 0695	55
6	3147	.294 0403	6764	.327 2179	6597	9968	.376 2243	3371	54
7	5941	3183	9529	4928	9329	.360 2682	4938	6047	53
8	8736	5963	.311 2294	7676	.344 2060	5395	7632	8722	52
9	.278 1530	8743	5058	.328 0424	4791	8108	.377 0327	.393 1397	51
10	4324	.295 1522	7822	3172	7521	.361 0821	3021	4071	50
11	7118	4302	.312 0586	5919	.345 0252	3534	5714	6745	49
12	9911	7081	3349	8666	2982	6246	8408	9419	48
13	.279 2704	9859	6112	.329 1413	5712	8958	.378 1101	.394 2093	47
14	5497	.296 2638	8875	4160	8441	.362 1609	3794	4766	46
15	8290	5416	.313 1638	6906	.346 1171	4380	6486	7439	45
16	.280 1083	8194	4400	9653	3900	7091	9178	.395 0111	44
17	3875	.297 0971	7163	.330 2398	6628	9802	.379 1870	2783	43
18	6667	3749	9925	5144	9357	.363 2512	4562	5455	42
19	9459	6526	.314 2086	7889	.347 2085	5222	7253	8127	41
20	.281 2251	9303	5448	.331 0634	4812	7932	9944	.396 0798	40
21	5042	.298 2079	8209	3379	7540	.364 0641	380 2634	3468	39
22	7833	4856	.315 0969	6123	.348 0267	3351	5324	6139	38
23	.282 0624	7632	3730	8867	2994	6059	8014	8809	37
24	3415	.299 0408	6490	.332 1611	5720	8768	.381 0704	.397 1479	36
25	6205	3184	9250	4355	8447	.365 1476	3393	4148	35
26	8995	5959	.316 2010	7098	.349 1173	4184	6082	6818	34
27	.283 1785	8734	4770	9841	3898	6891	8770	9486	33
28	4575	.300 1509	7529	.333 2584	6624	9599	.382 1459	.398 2155	32
29	7364	4284	.317 0288	5326	9349	.366 2306	4147	4823	31
30	.284 0153	7058	3047	8069	.350 2074	5012	6834	7491	30
31	2942	9832	5805	.334 0810	4798	7719	9522	.399 0159	29
32	5731	.301 2006	8563	3552	7523	.367 0425	.383 2209	2825	28
33	8520	5380	.318 1321	6293	.351 0246	3130	4895	5492	27
34	.285 1308	8153	4079	9034	2970	5836	7582	8158	26
35	4096	.302 0926	6836	.335 1775	5693	8541	.384 0268	.400 0825	25
36	6884	3699	9593	4516	8416	.368 1246	2953	3490	24
37	9671	6471	.319 2350	7256	.352 1139	3950	5639	6156	23
38	.286 2458	9244	5106	9996	3862	6654	8324	8821	22
39	5246	.303 2016	7863	.336 2735	6584	9358	.385 1008	.401 1486	21
40	8032	4788	.320 0619	5475	9806	.369 2061	3693	4150	20
41	.287 0819	7559	3374	8214	.353 2027	4765	6377	6814	19
42	3605	.304 0331	6130	.337 0953	4748	7468	9060	9478	18
43	6391	3102	8885	3691	7469	.370 0170	.386 1744	.402 2141	17
44	9177	5872	.321 1640	6429	.354 0190	2872	4427	4804	16
45	.288 1963	8643	4395	9167	2910	5574	7110	7467	15
46	4748	.305 1413	7149	.338 1905	5630	8276	9792	.403 0129	14
47	7533	4183	9903	4642	8350	.371 0977	.387 2474	2791	13
48	.289 0318	6953	.322 2657	7379	.355 1070	3678	5156	5453	12
49	3103	9723	5411	.339 0116	3789	6379	7837	8114	11
50	5887	.306 2492	8164	2852	6508	9079	.388 0518	.404 0775	10
51	8671	5261	.323 0917	5589	9226	.372 1780	3199	3436	9
52	.290 1455	8030	3670	8325	.356 1944	4479	5880	6096	8
53	4239	.307 0798	6422	.340 1060	4662	7179	8560	8756	7
54	7022	3566	9174	3796	7380	9878	.389 1240	.405 1416	6
55	9805	6334	.324 1926	6531	.357 0097	.373 2577	3919	4075	5
56	.291 2588	9102	4678	9265	2814	5275	6598	6734	4
57	5371	.308 1869	7429	.341 2000	5531	7973	9277	9393	3
58	8153	4636	.325 0180	4734	8248	.374 0671	.390 1955	.406 2051	2
59	.292 0935	7403	2931	7468	.358 0964	3369	4633	4709	1
60	3717	.309 0170	5682	.342 0201	3679	6066	7311	7366	0
/	73°	72°	71°	70°	69°	68°	67°	66°	/

NAT. COSINE.

	24°	25°	26°	27°	28°	29°	30°	31°	
0	406 7366	422 6183	438 3711	453 9905	469 4716	484 8096	500 0000	515 0381	60
1	407 0024	8819	6328	454 2497	7284	485 0640	2519	2874	59
2	2681	423 1455	8940	5088	9852	3184	5037	5867	58
3	5337	4090	439 1553	7679	470 2419	5727	7556	7859	57
4	7993	6725	4166	455 0269	4986	8270	501 0073	516 0351	56
5	408 0649	9360	6779	2859	7553	486 0812	2591	2842	55
6	3305	424 1994	9392	5449	471 0119	3354	5107	5333	54
7	5960	4628	440 2004	8038	2685	5895	7624	7824	53
8	8615	7262	4615	456 0627	5250	8436	502 0140	517 0314	52
9	409 1269	9895	7227	3216	7815	487 0977	2655	2804	51
10	3923	425 2528	9838	5804	472 0380	3517	5170	5293	50
11	6577	5161	441 2448	8392	2944	6057	7685	7782	49
12	9230	7793	5059	457 0979	5508	8597	503 0199	518 0270	48
13	410 1883	426 0425	7668	3566	8071	488 1136	2713	2758	47
14	4536	3056	442 0278	6153	473 0634	3674	5227	5246	46
15	7189	5687	2887	8739	3197	6212	7740	7733	45
16	9841	8318	5496	458 1325	5759	8750	504 0252	519 0219	44
17	411 2492	427 0949	8104	3910	8321	489 1288	2765	2705	43
18	5144	3579	443 0712	6496	474 0882	3825	5276	5191	42
19	7795	6208	3319	9080	8443	6361	7788	7676	41
20	412 0445	8838	5927	459 1665	6004	8897	505 0298	520 0161	40
21	3096	428 1467	8534	4248	8564	490 1433	2809	2646	39
22	5745	4095	444 1140	6832	475 1124	3968	5319	5130	38
23	8395	6723	3746	9415	3683	6503	7828	7613	37
24	413 1044	9351	6352	460 1998	6242	9038	506 0338	521 0096	36
25	3693	429 1979	8957	4580	8801	491 1572	2846	2579	35
26	6342	4606	445 1562	7162	476 1359	4105	5355	5061	34
27	8990	7233	4167	9744	3917	6638	7863	7543	33
28	414 1638	9859	6771	461 2325	6474	9171	507 0370	522 0024	32
29	4285	430 2485	9375	4906	9031	492 1704	2877	2505	31
30	6932	5111	446 1978	7486	477 1588	4236	5384	4986	30
31	9579	7736	4581	462 0066	4144	0767	7890	7466	29
32	415 2226	431 0361	7184	2646	6700	9298	508 0396	9945	28
33	4872	2986	9786	5225	9255	493 1829	2901	523 2424	27
34	7517	5610	447 2388	7804	478 1810	4359	5406	4903	26
35	416 0163	8234	4990	463 0382	4364	6889	7910	7381	25
36	2808	432 0857	7591	2960	6919	9419	509 0414	9859	24
37	5453	3481	448 0192	5538	9472	494 1948	2918	524 2336	23
38	8097	6103	2792	8115	479 2026	4476	5421	4813	22
39	417 0741	8726	5392	464 0692	4579	7005	7924	7290	21
40	3385	433 1348	7992	3269	7131	9532	510 0426	9766	20
41	6028	3970	449 0591	5845	9683	495 2060	2928	525 2241	19
42	8671	6591	3190	8420	480 2235	4587	5429	4717	18
43	418 1313	9212	5789	465 0996	4786	7113	7936	7191	17
44	3956	434 1832	8387	3571	7337	9639	511 0431	9665	16
45	6597	4453	450 0984	6145	9888	496 2165	2931	526 2139	15
46	9239	7072	3582	8719	481 2438	4690	5431	4613	14
47	419 1880	9692	6179	466 1293	4987	7215	7930	7085	13
48	4521	435 2311	8775	3866	7537	9740	512 0429	9558	12
49	7161	4930	451 1372	6439	482 0086	497 2264	2927	527 2030	11
50	9801	7548	3967	9012	2634	4787	5425	4502	10
51	420 2441	436 0166	6563	467 1584	5182	7310	7923	6973	9
52	5080	2784	9158	4156	7730	9833	513 0420	9443	8
53	7719	5401	452 1753	6727	483 0277	498 2355	2916	528 1914	7
54	421 0358	8018	4347	9298	2824	4877	5413	4383	6
55	2996	437 0634	6041	468 1869	5370	7399	7908	6853	5
56	5634	3251	9535	4439	7916	9920	514 0404	9322	4
57	8272	5866	453 2128	7009	484 0462	499 2441	2899	529 1790	3
58	422 0909	8482	4721	9578	3007	4961	5393	4258	2
59	3546	438 1097	7313	469 2147	5552	7481	7887	6726	1
60	6183	3711	9905	4716	8096	500 0000	515 0381	9193	0
/	65°	64°	63°	62°	61°	60°	59°	58°	/

NAT. COSINE.

32°	33°	34°	35°	36°	37°	38°	39°	/
529 9193	544 6390	559 1929	573 5764	587 7853	601 8150	615 6615	629 3204	60
530 1659	8830	4340	8147	588 0206	602 0473	8907	5464	59
4125	545 1269	6751	574 0529	2558	2795	616 1198	7724	58
6591	3707	9162	2911	4910	5117	3489	9983	57
9057	6145	560 1572	5292	7262	7439	5780	630 2242	56
531 1521	8583	3981	7672	9613	9760	8069	4500	55
3986	546 1020	6390	575 0053	589 1964	603 2080	617 0359	6758	54
6450	3456	8798	2432	4314	4400	2648	9015	53
8913	5892	561 1206	4811	6663	6719	4936	631 1272	52
532 1376	8328	3614	7190	9012	9038	7224	3528	51
3839	547 0763	6021	9568	590 1361	604 1356	9511	5784	50
6301	3198	8428	576 1946	3709	3674	618 1798	8039	49
8763	5632	562 0834	4323	6057	5991	4084	632 0293	48
533 1224	8066	3239	6700	8404	8308	6370	2547	47
3685	548 0499	5645	9076	591 0750	605 0624	8655	4800	46
6145	2932	8049	577 1452	3096	2940	619 0939	7053	45
8605	5365	563 0453	3827	5442	5255	3224	9306	44
534 1065	7797	2857	6202	7787	7570	5507	633 1557	43
3523	549 0228	5260	8576	592 0132	9884	7790	3809	42
5982	2659	7663	578 0950	2476	606 2198	620 0073	6059	41
8440	5090	564 0066	3323	4819	4511	2355	8310	40
535 0898	7520	2467	5696	7163	6824	4636	634 0559	39
3355	9950	4869	8069	9505	9136	6917	2808	38
5812	550 2379	7270	579 0440	593 1847	607 1447	9198	5057	37
8268	4807	9670	2812	4189	3758	621 1478	7305	36
536 0724	7236	565 2070	5183	6530	6069	3757	9553	35
3179	9663	4469	7553	8871	8379	6036	635 1800	34
5634	551 2091	6868	9923	594 1211	608 0689	8314	4046	33
8089	4518	9267	580 2292	3550	2998	622 0592	6292	32
537 0543	6944	566 1665	4661	5889	5306	2870	8537	31
2996	9370	4062	7030	8228	7614	5146	636 0782	30
5449	552 1795	6459	9397	595 0566	9922	7423	3026	29
7902	4220	8856	581 1765	2904	609 2229	9698	5270	28
538 0354	6645	567 1252	4132	5241	4535	623 1974	7513	27
2806	9069	3648	6498	7577	6841	4248	9756	26
5257	553 1492	6043	8864	9913	9147	6522	637 1998	25
7708	3915	8437	582 1230	596 2249	610 1452	8796	4240	24
539 0158	6338	568 0832	3595	4584	3756	624 1069	6481	23
2608	8760	3225	5959	6918	6060	3342	8721	22
5058	554 1182	5619	8323	9252	8363	5614	638 0961	21
7507	3603	8011	583 0687	597 1586	611 0666	7885	3201	20
9955	6024	569 0403	3050	3919	2969	625 0156	5440	19
540 2403	8444	2795	5412	6251	5270	2427	7678	18
4851	555 0864	5187	7774	8583	7572	4696	9916	17
7298	3283	7577	584 0136	598 0915	9873	6966	639 2153	16
9745	5702	9968	2497	3246	612 2173	9235	4390	15
541 2191	8121	570 2357	4857	5577	4473	626 1503	6626	14
4637	556 0539	4747	7217	7906	6772	3771	8862	13
7082	2956	7136	9577	599 0236	9071	6038	640 1097	12
9527	5373	9524	585 1966	2565	613 1369	8305	3332	11
542 1971	7790	571 1912	4294	4893	3666	627 0571	5566	10
4415	557 0206	4299	6652	7221	5964	2837	7799	9
6859	2621	6686	9010	9549	8260	5102	641 0032	8
9302	5036	9073	586 1367	600 1876	614 0556	7366	2264	7
543 1744	7451	572 1459	3724	4202	2852	9631	4496	6
4187	9865	3844	6080	6528	5147	628 1894	6728	5
6628	558 2279	6229	8435	8854	7442	4157	8958	4
9069	4692	8614	587 0790	601 1179	9736	6420	642 1189	3
544 1510	7105	573 0998	3145	3503	615 2029	8682	3418	2
3951	9517	3381	5499	5827	4322	629 0943	5647	1
6390	559 1929	5764	7853	8150	6615	3204	7876	0
57°	56°	55°	54°	53°	52°	51°	50°	/

NAT. COSINE.

	40°	41°	42°	43°	44°	45°	46°	47°	
0	642 7876	656 0590	669 1306	681 9984	694 6584	707 1068	719 3396	731 8537	60
1	643 0104	2785	3468	682 2111	8676	3124	6418	5521	59
2	2332	4980	5628	4237	695 0767	5180	7438	7503	58
3	4559	7174	7789	6363	2858	7236	9457	9486	57
4	6785	9367	9948	8489	4949	9291	720 1476	782 1467	56
5	9011	657 1560	670 2108	683 0613	7039	708 1345	3494	3449	55
6	644 1236	3752	4266	2738	9128	3398	6511	5429	54
7	3461	5944	6424	4861	696 1217	5451	7528	7409	53
8	5685	8135	8582	6984	3305	7504	9544	9388	52
9	7909	658 0326	671 0739	9107	5392	9556	721 1559	733 1367	51
10	645 0132	2516	2895	684 1229	7479	709 1607	3574	3345	50
11	2355	4706	5051	3350	9565	3657	5589	5322	49
12	4577	6895	7206	5471	697 1651	5707	7002	7299	48
13	6798	9083	9361	7591	3736	7757	9615	9275	47
14	9019	659 1271	672 1515	9711	5821	9806	722 1328	734 1250	46
15	646 1240	3458	3668	685 1830	7905	710 1854	3646	3225	45
16	3460	5645	5821	3948	9988	3901	5651	5199	44
17	5679	7831	7973	6066	698 2071	5948	7061	7173	43
18	7898	660 0017	673 0125	8184	4153	7995	9671	9146	42
19	647 0116	2202	2276	686 0300	6234	711 0041	723 1681	735 1118	41
20	2334	4386	4427	2416	8315	2086	3690	3090	40
21	4551	6570	6577	4532	699 0396	4130	5698	5061	39
22	6767	8754	8727	6647	2476	6174	7705	7032	38
23	8984	661 0936	674 0876	8761	4555	8218	9712	9002	37
24	648 1199	3119	3024	687 0875	6633	712 0260	724 1719	736 0971	36
25	3414	5300	5172	2988	8711	2303	3724	2940	35
26	5628	7482	7319	5101	700 0789	4344	5729	4908	34
27	7842	9662	9466	7213	2866	6385	7734	6875	33
28	649 0056	662 1842	675 1612	9325	4942	8426	9738	8842	32
29	2268	4022	3757	688 1435	7018	713 0465	725 1741	737 0808	31
30	4480	6200	5902	3546	9093	2504	3744	2773	30
31	6692	8379	8046	5655	701 1167	4543	5746	4738	29
32	8903	663 0557	676 0190	7765	3241	6581	7747	6703	28
33	650 1114	2734	2333	9873	5314	8618	9748	8666	27
34	3324	4910	4476	689 1981	7387	714 0655	726 1748	738 0629	26
35	5533	7087	6618	4089	9459	2691	3748	2592	25
36	7742	9262	8760	6195	702 1531	4727	5747	4553	24
37	9951	664 1437	677 0901	8302	3601	6762	7745	6515	23
38	651 2158	3612	3041	690 0407	5672	8796	9743	8475	22
39	4366	5785	5181	2512	7741	715 0830	727 1740	739 0435	21
40	6572	7959	7320	4617	9811	2863	3736	2394	20
41	8778	665 0131	9459	6721	703 1879	4895	5732	4353	19
42	652 0984	2304	678 1597	8824	3947	6927	7728	6311	18
43	3189	4475	3734	691 0927	6014	8959	9722	8268	17
44	5394	6646	5871	3029	8081	716 0989	728 1716	740 0225	16
45	7598	8817	8007	5131	704 0147	3019	3710	2181	15
46	9801	666 0987	679 0143	7232	2213	5049	5703	4137	14
47	653 2004	3156	2278	9332	4278	7078	7695	6092	13
48	4206	5325	4413	692 1432	6342	9106	9686	8046	12
49	6408	7493	6547	3531	8406	717 1134	729 1677	741 0000	11
50	8609	9661	8681	5630	705 0469	3161	3668	1953	10
51	654 0810	667 1828	680 0813	7728	2532	5187	5657	3905	9
52	3010	3994	2946	9825	4594	7213	7646	5857	8
53	5209	6160	5078	693 1922	6655	9238	9635	7808	7
54	7408	8326	7209	4018	8716	718 1263	730 1823	9758	6
55	9607	668 0490	9339	6114	706 0776	3287	3610	742 1708	5
56	655 1804	2655	681 1469	8209	2835	5310	5597	3658	4
57	4002	4818	3599	694 0304	4894	7333	7583	5606	3
58	6198	6981	5728	2398	6953	9355	9568	7554	2
59	8395	9144	7856	4491	9011	719 1377	731 1553	9502	1
60	656 0590	669 1306	9984	6584	707 1068	3398	3537	743 1448	0
	49°	48°	47°	46°	45°	44°	43°	42°	

°	48°	49°	50°	51°	52°	53°	54°	°
0	743 1448	754 7096	766 0444	777 1460	788 0108	798 6355	809 0170	00
1	3394	9004	2314	3290	1898	8105	1879	59
2	5340	755 0911	4183	5120	3688	9856	3588	58
3	7285	2818	6051	6949	5477	799 1604	5296	57
4	9229	4724	7918	8777	7266	3352	7004	56
5	744 1173	6630	9785	778 0604	9054	5100	8710	55
6	3115	8535	767 1652	2431	789 0841	6847	810 0416	54
7	5058	756 0439	3517	4258	2627	8593	2122	53
8	6999	2342	5382	6084	4413	800 0338	3826	52
9	8941	4246	7246	7909	6198	2083	5530	51
10	745 0881	6148	9110	9733	7983	3827	7234	50
11	2821	8050	768 0973	779 1557	9767	5571	8936	49
12	4760	9951	2835	3380	790 1550	7314	811 0638	48
13	6699	757 1851	4697	5202	3333	9066	2339	47
14	8636	3751	6558	7024	5115	801 0797	4040	46
15	746 0574	5650	8418	8845	6896	2538	5740	45
16	2510	7548	769 0278	780 0665	8676	4278	7439	44
17	4446	9446	2137	2485	791 0456	6018	9137	43
18	6382	758 1343	3996	4304	2235	7756	812 0835	42
19	8317	3240	5853	6123	4014	9495	2532	41
20	747 0251	5136	7710	7940	5792	802 1232	4229	40
21	2184	7031	9567	9757	7569	2969	5925	39
22	4117	8928	770 1423	781 1574	9345	4705	7620	38
23	6049	759 0820	3278	3390	792 1121	6440	9314	37
24	7981	2713	5132	5205	2896	8175	813 1008	36
25	9912	4606	6986	7019	4671	9909	2701	35
26	748 1842	6498	8840	8833	6445	803 1642	4393	34
27	3772	8389	771 0692	782 0646	8218	3875	6084	33
28	5701	760 0280	2544	2459	9990	5107	7775	32
29	7629	2170	4396	4270	793 1762	6838	9466	31
30	9557	4060	6246	6082	8533	8569	814 1155	30
31	749 1484	5949	8096	7892	5304	804 0299	2844	29
32	3411	7837	9945	9702	7074	2028	4532	28
33	5337	9724	772 1794	783 1511	8843	3756	6220	27
34	7262	761 1611	3642	3320	794 0611	5484	7906	26
35	9187	3497	5489	5127	2379	7211	9593	25
36	750 1111	5383	7336	6935	4146	8938	815 1278	24
37	3034	7268	9182	8741	5913	805 0664	2963	23
38	4957	9152	773 1027	784 0547	7678	2389	4647	22
39	6879	762 1036	2872	2352	9444	4113	6830	21
40	8800	2919	4716	4157	795 1208	5837	8013	20
41	751 0721	4802	6559	5961	2972	7560	9695	19
42	2641	6683	8402	7764	4735	9283	816 1376	18
43	4561	8564	774 0244	9566	6497	806 1005	3056	17
44	6480	763 0445	2086	785 1368	8259	2726	4736	16
45	8398	2325	3926	3169	796 0020	4446	6416	15
46	752 0316	4204	5767	4970	1780	6166	8094	14
47	2233	6082	7606	6770	3540	7885	9772	13
48	4149	7960	9445	8569	5299	9603	817 1449	12
49	6065	9838	775 1293	786 0367	7058	807 1321	3125	11
50	7980	764 1714	3121	2165	8815	3038	4801	10
51	9894	3590	4957	3963	797 0572	4754	6476	9
52	753 1808	5465	6794	5759	2329	6470	8151	8
53	3721	7340	8629	7555	4084	8185	9824	7
54	5634	9214	776 0464	9350	5839	9899	813 1497	6
55	7546	765 1087	2298	787 1145	7594	808 1612	3169	5
56	9457	2990	4132	2939	9347	3325	4841	4
57	754 1368	4832	5965	4732	798 1100	5037	6512	3
58	3278	6704	7797	6524	2853	6749	8182	2
59	5187	8574	9629	8316	4604	8460	9852	1
60	7096	766 0444	777 1460	788 0108	6355	809 0170	819 1520	0
°	41°	40°	39°	38°	37°	36°	35°	°

NAT. COSINE.

	55°	56°	57°	58°	59°	60°	61°	
0	819 1520	829 0376	838 6706	848 0481	857 1673	866 0254	874 6197	00
1	3189	2002	8290	2022	3171	1708	7607	50
2	4856	3628	9873	3562	4668	3161	9016	58
3	6523	5252	839 1455	5102	6164	4614	875 0425	57
4	8189	6877	3037	6641	7060	6066	1832	56
5	9854	8500	4618	8179	9155	7517	3239	55
6	820 1519	830 0123	6199	9717	858 0649	8967	4645	54
7	3183	1745	7778	849 1254	2143	867 0417	6051	53
8	4846	3366	9357	2790	3635	1866	7455	52
9	6509	4987	840 0936	4325	5127	3314	8859	51
10	8170	6607	2513	5860	6619	4762	876 0263	50
11	9832	8226	4090	7394	8109	6209	1666	49
12	821 1492	9845	5666	8927	9599	7655	3067	48
13	3152	831 1463	7241	850 0459	859 1088	9100	4468	47
14	4811	3080	8816	1991	2576	868 0544	5868	46
15	6469	4666	841 0390	3522	4064	1988	7268	45
16	8127	6312	1963	5053	5551	3431	8666	44
17	9784	7927	3536	6582	7037	4874	877 0064	43
18	822 1440	9541	5108	8111	8623	6315	1462	42
19	3096	832 1155	6679	9639	860 0007	7756	2858	41
20	4751	2768	8249	851 1167	1491	9196	4254	40
21	6405	4380	9819	2693	2975	869 0636	5649	39
22	8059	5991	842 1388	4219	4457	2074	7043	38
23	9712	7602	2956	5745	5939	3512	8437	37
24	823 1364	9212	4524	7269	7420	4949	9830	36
25	3015	833 0822	6091	8793	8901	6386	878 1222	35
26	4666	2430	7657	852 0316	861 0380	7821	2613	34
27	6316	4038	9222	1839	1859	9256	4004	33
28	7965	5646	843 0787	3360	3337	870 0691	5394	32
29	9614	7252	2351	4881	4815	2124	6783	31
30	824 1262	8858	3914	6402	6292	3587	8171	30
31	2909	834 0463	5477	7921	7768	4989	9559	29
32	4556	2068	7039	9440	9243	6420	879 0946	28
33	6202	3672	8600	853 0958	862 0717	7851	2232	27
34	7847	5275	844 0161	2475	2191	9281	3717	26
35	9491	6877	1720	3992	3664	871 0710	5102	25
36	825 1135	8479	3279	5508	5137	2138	6486	24
37	2778	835 0080	4838	7023	6608	3566	7869	23
38	4420	1680	6395	8538	8079	4993	9251	22
39	6062	3279	7952	854 0051	9549	6419	880 0633	21
40	7703	4878	9508	1564	863 1019	7844	2014	20
41	9343	6476	845 1064	3077	2488	9269	3394	19
42	826 0983	8074	2618	4588	3956	872 0693	4774	18
43	2622	9670	4172	6099	5423	2116	6152	17
44	4260	836 1266	5726	7609	6889	3538	7530	16
45	5897	2862	7278	9119	8355	4960	8907	15
46	7534	4456	8830	855 0627	9820	6381	881 0284	14
47	9170	6050	846 0381	2135	864 1284	7801	1660	13
48	827 0806	7643	1932	3643	2748	9221	3035	12
49	2440	9236	3481	5149	4211	873 0640	4409	11
50	4074	837 0827	5030	6655	5673	2058	5782	10
51	5708	2418	6579	8160	7134	3475	7155	9
52	7340	4009	8126	9664	8595	4891	8527	8
53	8972	5598	9673	856 1168	865 0065	6307	9898	7
54	828 0603	7187	847 1219	2671	1514	7722	882 1269	6
55	2234	8775	2765	4173	2973	9137	2638	5
56	3864	838 0363	4309	5674	4430	874 0550	4007	4
57	5493	1950	5553	7175	5887	1963	5376	3
58	7121	3536	7397	8675	7344	3375	6743	2
59	8749	5121	8939	857 0174	8799	4786	8110	1
60	829 0376	6706	848 0481	1673	866 0254	6197	9476	0
	34°	33°	32°	31°	30°	29°	28°	

/	62°	63°	64°	65°	66°	67°	68°	/
0	.882 9476	.891 0065	.898 7940	.906 3078	.913 5455	.920 5049	.927 1839	60
1	.883 0841	1385	9215	4307	6637	6185	2928	59
2	2206	2705	.899 0489	5535	7819	7320	4016	58
3	3569	4024	1763	6762	9001	8455	5104	57
4	4933	5342	3035	7989	.914 0181	9589	6191	56
5	6295	6659	4307	9215	1361	.921 0722	7277	55
6	7658	7975	5578	.907 0440	2540	1854	8363	54
7	9017	9291	6848	1665	3718	2986	9447	53
8	.884 0377	.892 0006	8117	2888	4895	4116	.928 0531	52
9	1736	1920	9386	4111	6072	6246	1614	51
10	3095	3234	.900 0654	5333	7247	6375	2696	50
11	4453	4546	1921	6554	8422	7504	3778	49
12	5810	5858	3188	7775	9597	8632	4858	48
13	7166	7169	4453	8995	.915 0770	9758	5938	47
14	8522	8480	5718	.908 0214	1943	.922 0884	7017	46
15	9876	9789	6982	1432	3115	2010	8096	45
16	.885 1230	.893 1098	8246	2649	4286	3134	9173	44
17	2584	2406	9508	3866	5456	4258	.929 0250	43
18	3936	3714	.901 0770	5082	6626	5381	1326	42
19	5288	5021	2031	6297	7795	6503	2401	41
20	6639	6326	3292	7511	8963	7624	3475	40
21	7989	7632	4551	8725	.916 0130	8745	4549	39
22	9339	8936	5810	9938	1297	9865	5622	38
23	.886 0688	.894 0240	7068	.909 1150	2462	.923 0984	6694	37
24	2036	1542	8325	2361	3627	2102	7765	36
25	3383	2844	9582	3572	4791	3220	8835	35
26	4730	4146	.902 0838	4781	5955	4336	9905	34
27	6075	5446	2092	5990	7118	5452	.930 0974	33
28	7420	6746	3347	7199	8279	6567	2042	32
29	8765	8045	4600	8406	9440	7682	3109	31
30	.887 0108	9344	5853	9613	.917 0601	8795	4176	30
31	1451	.895 0641	7105	.910 0819	1760	9908	5241	29
32	2793	1938	8356	2024	2919	.924 1020	6306	28
33	4134	3234	9606	3228	4077	2131	7370	27
34	5475	4529	.903 0856	4432	5234	3242	8434	26
35	6815	5824	2105	5635	6391	4351	9496	25
36	8154	7118	3353	6837	7546	5460	.931 0558	24
37	9492	8411	4600	8038	8701	6568	1619	23
38	.888 0830	9703	5847	9238	9855	7676	2679	22
39	2166	.896 0994	7093	.911 0438	.918 1009	8782	3739	21
40	3503	2285	8338	1637	2161	9888	4797	20
41	4838	3575	9582	2835	3313	.925 0993	5855	19
42	6172	4864	.904 0825	4033	4464	2097	6912	18
43	7506	6153	2068	5229	5614	3201	7969	17
44	8839	7440	3310	6425	6763	4303	9024	16
45	.889 0171	8727	4551	7620	7912	5405	.932 0079	15
46	1503	.897 0014	5792	8815	9060	6506	1133	14
47	2834	1299	7032	.912 0008	.919 0207	7606	2186	13
48	4164	2584	8271	1201	1353	8706	3238	12
49	5493	3868	9509	2393	2499	9805	4290	11
50	6822	5151	.905 0746	3584	3644	.926 0902	5340	10
51	8149	6433	1983	4775	4788	2000	6390	9
52	9476	7715	3219	5965	5931	3096	7439	8
53	.890 0803	8996	4454	7154	7073	4192	8488	7
54	2128	.898 0276	5688	8342	8215	5286	9535	6
55	3453	1555	6922	9529	9356	6380	.933 0582	5
56	4777	2834	8154	.913 0716	.920 0496	7474	1628	4
57	6100	4112	9386	1902	1635	8566	2673	3
58	7423	5389	.906 0618	3087	2774	9658	3718	2
59	8744	6665	1848	4271	3912	.927 0748	4761	1
60	.891 0065	7940	3078	5455	5049	1839	5804	0
/	27°	26°	25°	24°	23°	22°	21°	/

	69°	70°	71°	72°	73°	74°	75°	
0	933 5804	939 6926	945 5186	951 0565	956 3048	961 2617	965 9258	60
1	6846	7921	6132	1464	3898	3418	966 0011	59
2	7888	8914	7078	2361	4747	4219	0762	58
3	8928	9907	8023	3258	5595	5019	1513	57
4	9968	940 0899	8968	4154	6443	5818	2263	56
5	934 1007	1891	9911	5050	7290	6616	3012	55
6	2045	2881	940 0854	5944	8136	7413	3761	54
7	3082	3871	1795	6838	8981	8210	4508	53
8	4119	4860	2736	7731	9825	9005	5255	52
9	5154	5848	3677	8623	957 0669	9800	6001	51
10	6189	6835	4616	9514	1512	962 0594	6746	50
11	7223	7822	5555	952 0404	2354	1387	7490	49
12	8257	8808	6493	1294	3195	2180	8234	48
13	9289	9793	7430	2183	4035	2972	8977	47
14	935 0321	941 0777	8366	3071	4875	3762	9718	46
15	1352	1760	9301	3958	5714	4552	967 0459	45
16	2382	2743	947 0236	4844	6552	5342	1200	44
17	3412	3724	1170	5730	7389	6130	1939	43
18	4440	4705	2103	6615	8225	6917	2678	42
19	5468	5686	3035	7499	9060	7704	3415	41
20	6495	6665	3966	8382	9895	8490	4152	40
21	7521	7644	4897	9264	958 0729	9275	4888	39
22	8547	8621	5827	953 0146	1562	963 0060	5624	38
23	9571	9598	6756	1027	2394	0843	6358	37
24	936 0595	942 0575	7684	1907	3226	1626	7092	36
25	1618	1550	8612	2786	4056	2408	7825	35
26	2641	2525	9538	3664	4886	3189	8557	34
27	3662	3498	948 0464	4542	5715	3969	9288	33
28	4683	4471	1389	5418	6543	4748	968 0018	32
29	5703	5444	2313	6294	7371	5527	0748	31
30	6722	6415	3237	7170	8197	6305	1476	30
31	7740	7386	4159	8044	9023	7081	2204	29
32	8758	8355	5081	8917	9848	7858	2931	28
33	9774	9324	6002	9790	959 0672	8633	3658	27
34	937 0790	943 0293	6922	954 0662	1496	9407	4383	26
35	1806	1260	7842	1533	2318	964 0181	5108	25
36	2820	2227	8760	2403	3140	0954	5832	24
37	3833	3192	9678	3273	3961	1726	6555	23
38	4846	4157	949 0595	4141	4781	2497	7277	22
39	5858	5122	1511	5009	5600	3268	7998	21
40	6869	6085	2426	5876	6418	4037	8719	20
41	7880	7048	3341	6743	7236	4806	9438	19
42	8889	8010	4255	7608	8053	5574	969 0157	18
43	9898	8971	5168	8473	8869	6341	0875	17
44	938 0906	9931	6080	9336	9684	7108	1593	16
45	1913	944 0890	6991	955 0199	960 0499	7873	2309	15
46	2920	1849	7902	1062	1312	8638	3025	14
47	3925	2807	8812	1923	2125	9402	3740	13
48	4930	3764	9721	2784	2937	965 0165	4453	12
49	5934	4720	950 0629	3646	3748	0927	5167	11
50	6938	5675	1536	4502	4558	1689	5879	10
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52	8942	7584	3348	6218	6177	3209	7301	8
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54	939 0943	9489	5157	7930	7792	4726	8720	6
55	1942	945 0441	6061	8785	8598	5484	9428	5
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57	3938	2341	7865	956 0492	961 0208	6996	0842	3
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	20°	19°	18°	17°	16°	15°	14°	

/	76°	77°	78°	79°	80°	81°	82°	/
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2	4363	5008	2684	7380	9849 086	792	489	58
3	5065	5660	3287	7933	589	9878 245	891	57
4	5766	6311	3889	8485	9850 091	697	9904 238	56
5	6466	6962	4490	9037	593	9879 148	694	55
6	7165	7612	5090	9587	9851 093	599	9905 095	54
7	7863	8261	5689	982 0137	593	9880 048	494	53
8	8561	8909	6288	0686	9852 092	497	893	52
9	9258	9556	6886	1234	590	945	9906 290	51
10	9953	975 0203	7483	1781	9853 087	9881 392	687	50
11	971 0649	0849	8079	2327	583	838	9907 083	49
12	1343	1494	8674	2873	9854 079	9882 284	478	48
13	2036	2138	9268	3417	574	728	873	47
14	2729	2781	9862	3961	9855 068	9883 172	9908 266	46
15	3421	3423	979 0455	4504	561	615	659	45
16	4112	4066	1047	5046	9856 053	9884 057	9909 051	44
17	4802	4706	1638	5587	544	498	442	43
18	5491	5345	2228	6128	9857 035	939	832	42
19	6180	5985	2818	6668	524	9885 378	9910 221	41
20	6867	6623	3406	7206	9858 013	817	610	40
21	7554	7260	3994	7744	501	9886 255	997	39
22	8240	7897	4581	8282	988	692	9911 384	38
23	8926	8533	5167	8818	9859 475	9887 128	770	37
24	9610	9168	5752	9353	960	564	9912 155	36
25	972 0294	9802	6337	9888	9860 445	998	540	35
26	0976	976 0435	6921	983 0422	929	9888 432	923	34
27	1658	1067	7504	0955	9861 412	865	9913 306	33
28	2339	1699	8086	1487	894	9889 297	688	32
29	3020	2230	8667	2019	9862 375	728	9914 069	31
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32	5056	4217	980 0405	3608	815	9891 017	9915 206	28
33	5733	4845	0983	4136	9864 293	445	584	27
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35	7084	6098	2136	5189	9865 246	9892 238	9916 337	25
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37	8432	7347	3286	6239	9866 196	9893 148	9917 086	23
38	9105	7970	3860	6763	670	572	459	22
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40	973 0449	9215	5005	7808	615	9894 416	9918 204	20
41	1119	9836	5576	8330	9868 087	838	574	19
42	1789	977 0456	6147	8850	557	9895 258	944	18
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47	5124	3544	8986	1441	897	9697 347	782	13
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/	83°	84°	85°	86°	87°	88°	89°	/
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2	-9926 169	825	452	-9976 045	598	110	577	58
3	521	-9946 127	704	245	748	209	625	57
4	873	428	954	445	898	308	673	56
5	-9927 224	729	-9963 204	645	-9987 046	405	720	55
6	573	-9947 028	453	843	194	502	766	54
7	922	327	701	-9977 040	340	598	812	53
8	-9928 271	625	948	237	486	693	856	52
9	618	921	-9964 195	433	631	788	900	51
10	965	-9948 217	440	627	775	881	942	50
11	-9929 310	513	685	821	919	974	984	49
12	655	807	929	-9978 015	-9988 061	-9995 066	-9999 025	48
13	999	-9949 101	-9965 172	207	203	157	065	47
14	-9930 342	393	414	399	344	247	106	46
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16	-9931 026	976	895	779	623	424	181	44
17	367	-9950 266	-9966 135	968	761	512	218	43
18	706	556	374	-9979 156	599	599	254	42
19	-9932 045	844	612	343	-9989 035	684	289	41
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22	-9933 057	705	321	900	440	937	389	38
23	393	990	555	-9980 084	573	-9996 020	421	37
24	728	-9952 274	789	267	706	101	452	36
25	-9934 062	557	-9968 022	450	837	182	482	35
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27	727	-9953 122	485	811	-9990 098	341	539	33
28	-9935 058	403	715	991	227	419	567	32
29	389	683	945	-9981 170	355	497	593	31
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31	-9936 047	-9954 240	401	525	609	649	644	29
32	375	517	628	701	734	724	668	28
33	703	794	854	877	859	798	692	27
34	-9937 029	-9955 070	-9970 080	-9982 062	983	871	714	26
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36	679	620	528	398	228	-9997 015	756	24
37	-9938 003	893	750	570	350	086	776	23
38	326	-9956 165	972	742	470	156	795	22
39	648	437	-9971 193	912	590	224	813	21
40	969	708	413	-9983 082	709	292	831	20
41	-9939 290	978	633	250	827	360	847	19
42	610	-9957 247	851	418	944	426	863	18
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48	510	844	-9973 145	408	629	807	939	12
49	823	-9959 107	357	570	740	867	949	11
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55	688	669	615	524	390	213	989	5
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3	8727	3280	7945	053 2829	8038	3681	9866	6705	57
4	001 1636	6190	036 0858	5746	071 0961	6612	106 2808	9658	56
5	4544	9100	3771	8663	3885	9544	5750	124 2612	55
6	7453	019 2010	6683	054 1581	6809	089 2476	8692	5566	54
7	002 0362	4920	9596	4498	9733	5408	107 1634	8520	53
8	3271	7830	037 2500	7416	072 2657	8341	4576	125 1474	52
9	6180	020 0740	5422	055 0333	5581	090 1273	7519	4429	51
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13	7816	021 2380	7074	056 2005	7279	3004	9291	6249	47
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16	6542	022 1111	5814	057 0759	6053	092 1804	8122	5117	44
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20	8178	023 2753	7469	058 2434	7755	3540	9899	6943	40
21	006 1087	5663	041 0383	5352	076 0680	6474	111 2844	9900	39
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27	8541	3127	7866	060 2867	8237	4084	113 0517	7648	33
28	008 1450	6038	043 0781	5787	078 1164	7019	3463	131 0607	32
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32	3087	7681	044 2438	7466	079 2871	8763	5250	132 2444	28
33	5996	027 0592	5353	062 0386	5798	097 1699	8197	5404	27
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37	7633	028 2236	7012	063 2067	7509	3446	9987	7246	23
38	011 0542	5148	9927	4988	081 0437	6383	116 2936	134 0207	22
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40	6361	029 0970	5757	064 0829	6293	099 2257	8832	6129	20
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42	012 2179	6793	047 1588	6671	082 2150	8133	4730	135 2053	18
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45	013 0907	5528	048 0334	5435	082 0936	6947	3578	136 0940	15
46	3817	8439	3250	8356	3865	9886	6528	3903	14
47	6726	031 1351	6166	066 1278	6794	101 2824	9478	6866	13
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57	5821	034 0471	5328	063 0499	6094	104 2220	8988	6510	3
58	8731	3383	8244	3422	9025	5161	122 1941	9476	2
59	017 1641	6295	052 1161	6345	087 1956	8101	4893	140 2442	1
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3	4308	159 2791	177 2269	195 2861	4688	7876	250 2551	8847	57
4	7270	5774	5270	5881	7730	232 0941	5642	269 1967	56
5	142 0243	8757	8270	8901	214 0772	4007	8734	5087	55
6	3211	160 1740	178 1271	196 1922	3814	7073	251 1826	8207	54
7	6179	4724	4273	4943	6857	223 0140	4919	270 1328	53
8	9147	7708	7274	7964	9900	3207	8012	4449	52
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15	9931	8603	8295	9124	217 1213	4687	9676	6813	45
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18	8842	7563	7308	8197	218 0353	3900	8968	5690	42
19	146 1813	164 0550	182 0313	200 1222	3400	6971	255 2066	8817	41
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23	3699	165 2501	183 2337	3327	5593	9262	4463	275 1330	37
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25	9644	8478	8350	9381	220 1692	5410	257 0664	7589	35
26	148 2617	166 1467	184 1358	202 2409	4742	8485	3766	276 0719	34
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28	8563	7446	7373	8465	221 0844	4635	9970	6981	32
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35	9383	8381	8439	9674	223 2211	6176	260 1699	8915	25
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42	153 0215	9331	9520	207 0900	3597	7737	3451	281 0873	18
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47	5103	4304	4587	6073	8885	3151	9002	6573	13
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3	6900	6852	8848	345 3040	9588	8656	405 0417	5051	57
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5	3201	3218	5284	9553	6182	5337	7191	426 1924	55
6	6352	6402	8504	346 2810	9480	8679	406 0579	5361	54
7	9503	9586	327 1724	6068	366 2779	386 2021	3968	8800	53
8	289 2655	308 2771	4944	9327	6079	5364	7358	427 2239	52
9	5808	5957	8165	347 2586	9379	8708	407 0748	5680	51
10	8961	9143	328 1387	5846	367 2680	387 2053	4139	9121	50
11	290 2114	309 2330	4610	9107	5981	5398	7531	428 2563	49
12	5269	5517	7833	348 2368	9284	8744	408 0924	6005	48
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21	3680	4229	6868	351 1750	9036	8894	411 1497	7030	39
22	6839	7422	332 0097	5018	371 2346	391 2247	4898	432 0481	38
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24	294 3160	3810	6557	352 1556	8967	8957	412 1703	7386	36
25	6321	7005	9788	4826	372 2278	392 2313	5106	433 0840	35
26	9483	314 0200	333 3020	8096	5590	5670	8510	4295	34
27	295 2645	3396	6252	1368	8903	9027	413 1915	7751	33
28	5808	6593	9485	353 4640	373 2217	393 2386	5321	434 1208	32
29	8971	9790	334 2719	7912	5532	5745	8728	4665	31
30	296 2135	315 2988	5953	354 1186	8847	9105	414 2136	8124	30
31	5299	6186	9188	4460	374 2163	394 2465	5544	435 1583	29
32	8464	9385	335 2424	7734	5479	5827	8953	5043	28
33	297 1630	316 2585	5660	355 1010	8797	9189	415 2363	8504	27
34	4796	5785	8896	4286	375 2115	395 2552	5774	436 1966	26
35	7962	8986	336 2134	7562	5433	5916	9186	5429	25
36	298 1129	317 2187	5372	356 0840	8753	9280	416 2598	8893	24
37	4297	5389	8610	4118	376 2073	396 2645	6012	437 2357	23
38	7465	8591	337 1850	7397	5394	6011	9426	5823	22
39	299 0634	318 1794	5090	357 0676	8716	9378	417 2841	9289	21
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44	6486	7819	339 1299	7083	5335	6224	9928	6634	16
45	9658	320 1025	4543	359 0367	8661	9595	419 3348	440 0105	15
46	301 2831	4232	7787	3651	379 1988	399 2968	6769	3578	14
47	6004	7440	340 1032	6936	5315	6341	420 0190	7051	13
48	9178	321 0649	4278	360 0222	8644	9715	3613	441 0526	12
49	302 2352	3858	7524	3508	380 1973	400 3089	7036	4001	11
50	5527	7067	341 0771	6795	5302	6465	421 0460	7477	10
51	8703	322 0278	4019	361 0082	8633	9841	3885	442 0954	9
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55	304 1410	323 3125	7015	362 3240	382 1962	402 3354	7694	4871	5
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57	7767	9552	3518	9823	8631	403 0115	4453	444 1834	3
58	305 0946	324 2766	6770	363 3115	383 1967	3496	7884	5318	2
59	4126	5981	344 0023	6408	5303	6879	424 1316	8802	1
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/	24°	25°	26°	27°	28°	29°	30°	31°	/
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2	9200	467 0161	4530	510 2585	4559	555 0698	578 1262	6527	58
3	446 2747	3705	8133	6252	8293	4504	5144	602 0490	57
4	6236	7250	489 1737	9919	533 2029	8311	9027	4454	56
5	9726	468 0796	5543	511 3588	5765	556 2119	579 2912	8419	55
6	447 3216	4342	8949	7259	9503	5929	6797	603 2386	54
7	6708	7890	490 2557	512 0930	534 3242	9739	580 0684	6354	53
8	448 0200	469 1439	6166	4602	6981	557 3551	4573	604 0323	52
9	3693	4988	9775	8275	535 0723	7364	8462	4294	51
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13	7675	9196	4224	514 2980	5699	559 2629	4034	606 0192	47
14	450 1173	471 2751	7838	6658	9446	6449	7930	4170	46
15	4672	6306	493 1454	515 0338	537 3194	560 0269	583 1828	8149	45
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19	8676	473 0538	5928	5069	8198	5564	7431	4080	41
20	452 2179	4098	9549	8755	539 1952	9391	585 1335	8067	40
21	5683	7659	495 3171	517 2441	5707	562 3219	5241	609 2054	39
22	9188	474 1222	6794	6129	9404	7048	9148	6043	38
23	453 2694	4785	496 0418	9818	540 3221	563 0879	586 3056	610 0034	37
24	6201	8349	4043	518 3508	6980	4710	6965	4026	36
25	9709	475 1914	7669	7199	541 0740	8543	587 0876	8019	35
26	454 3218	5481	497 1297	519 0891	4501	564 2378	4788	611 2014	34
27	6728	9048	4925	4584	8263	6213	8702	6011	33
28	455 0238	476 2616	8554	8278	542 2027	565 0050	588 2616	612 0008	32
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30	7263	9755	5816	5671	9557	7728	589 0450	8008	30
31	456 0776	477 3326	9449	9368	543 3324	566 1568	4369	613 2010	29
32	4290	6899	499 3082	521 3067	7092	5410	8289	6013	28
33	7806	478 0472	6717	6767	544 0862	9254	590 2211	614 0018	27
34	457 1322	4046	500 0352	522 0468	4632	567 3098	6134	4024	26
35	4839	7621	3989	4170	8404	6044	591 0058	8032	25
36	8357	479 1197	7627	7874	545 2177	568 0791	3984	615 2041	24
37	458 1877	4774	501 1266	523 1578	5951	4639	7910	6052	23
38	5397	8352	4906	5284	9727	8488	592 1839	616 0064	22
39	8918	480 1932	8547	8990	546 3503	569 2339	5768	4077	21
40	459 2439	5512	502 2189	524 2698	7281	6191	9699	8092	20
41	5962	9093	5832	6407	547 1060	570 0045	593 3632	617 2108	19
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43	460 3011	6258	503 3121	3829	8621	7755	594 1501	618 0145	17
44	6537	9842	6768	7541	548 2404	571 1612	5437	4166	16
45	461 0063	482 3427	504 0415	526 1255	6188	5471	9375	8188	15
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47	7119	483 0601	7713	8685	549 3759	572 3192	7255	6236	13
48	462 0649	4189	505 1363	527 2402	7547	7054	596 1196	620 0263	12
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53	8310	485 2145	9633	529 1004	6502	6385	598 0926	622 0417	7
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57	465 2457	6528	4267	5906	553 1688	576 1873	6735	6566	3
58	5996	487 0126	7929	9634	5488	5748	600 0691	624 0607	2
59	9536	3726	509 1591	531 3364	9288	9625	4648	4650	1
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/	65°	64°	63°	62°	61°	60°	59°	58°	/

	32°	33°	34°	35°	36°	37°	38°	39°	
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2	6786	650 2360	675 3553	701 0749	727 4318	4666	782 2229	7478	58
3	626 0834	6490	7790	5089	9232	6919	811 2300	57	
4	4884	661 0631	676 2028	9430	728 3218	755 3799	783 1611	7124	56
5	8935	4774	6268	702 3773	7671	8369	6305	812 1951	55
6	627 2988	8918	677 0509	8118	729 2125	756 2941	784 1002	6780	54
7	7042	662 3064	4752	703 2464	6582	7514	6700	813 1611	53
8	628 1098	7211	8997	6813	730 1041	757 2090	785 0400	6444	52
9	5155	653 1360	678 3243	704 1163	5501	6668	5103	814 1280	51
10	9214	5511	7492	5515	9963	758 1248	9808	6118	50
11	629 3274	9863	679 1741	9869	731 4428	5829	786 4515	815 0958	49
12	7336	654 3817	5993	705 4224	8894	759 0413	9224	5801	48
13	630 1399	7972	680 0246	8581	732 3362	4999	787 3935	816 0646	47
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15	9530	6287	8758	7301	733 2303	760 4177	788 3364	817 0343	45
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17	7667	4609	7276	6028	734 1253	761 3363	789 2802	819 0049	43
18	632 1738	8772	682 1537	708 0395	5730	7959	7524	4905	42
19	5810	657 2937	5801	4763	735 0210	762 2557	790 2248	9764	41
20	9883	7103	683 0066	9133	4691	7157	6975	819 4625	40
21	633 3959	658 1271	4333	709 3504	9174	763 1759	791 1703	9488	39
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23	634 2113	9612	684 2871	710 2253	8147	764 0969	792 1167	9222	37
24	6193	659 3785	7143	6630	737 2636	5577	5902	821 4093	36
25	635 0274	7990	685 1416	711 1009	7127	765 0188	793 0640	8965	35
26	4357	660 2136	5692	5390	738 1620	4800	5379	822 3840	34
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28	636 2527	661 0492	686 4247	712 4157	739 0611	766 4031	4865	823 3597	32
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33	638 2978	663 1413	5666	6106	741 3124	7144	8617	8031	27
34	7073	5801	9955	715 0501	7633	769 1773	797 3374	826 2925	26
35	639 1169	9792	689 4246	4898	742 2143	6404	8134	7821	25
36	5267	664 3984	8538	9297	6655	770 1037	798 2895	827 2719	24
37	9366	8178	690 2832	716 3698	743 1170	5672	7659	7620	23
38	640 3467	665 2373	7128	8100	5686	771 0309	799 2425	828 2523	22
39	7589	6570	691 1425	717 2505	744 0204	4948	7193	7429	21
40	641 1673	666 0769	5725	6911	4724	9589	800 1963	829 2337	20
41	5779	4969	692 0026	718 1319	9246	772 4233	6736	7247	19
42	9886	9171	4328	5729	745 3770	8878	801 1511	830 2160	18
43	642 3994	667 3374	8633	719 0141	8296	773 3526	6288	7075	17
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	40°	41°	42°	43°	44°	45°	46°	47°	
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3	5878	8200	9854	934 1479	967 3767	17469	73404	42467	57
4	841 0844	871 3316	902 5131	935 2380	968 5035	23298	79445	48734	56
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6	842 0782	872 3556	904 0979	936 3292	969 0674	34968	91538	61282	54
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8	843 0730	873 3806	905 1557	937 4216	970 1962	46651	1-04 03645	73845	52
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12	845 0655	875 4338	907 2746	939 0625	972 4575	70058	27904	99018	48
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17	5617	978 0062	909 3984	941 2545	974 1569	99394	58310	30573	43
18	848 0617	878 0062	910 4619	942 3523	975 2914	1-01 05272	64402	36896	42
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20	849 0624	879 0370	911 5265	943 4513	976 4272	17038	76598	49554	40
21	5631	880 0688	911 5265	943 4513	976 4272	22925	82702	55889	39
22	850 0640	880 0688	912 0592	944 0013	977 5643	28817	88809	62228	38
23	5653	881 1017	912 0592	944 0013	977 5643	34712	94920	68571	37
24	851 0667	881 1017	913 1255	945 1021	978 1333	40610	1-05 01034	74918	36
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26	852 0704	882 1357	914 1929	946 2042	979 2724	52418	13275	87624	34
27	5726	883 1707	914 1929	946 2042	979 2724	58326	19401	95984	33
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38	858 1133	888 3619	920 0841	953 3971	985 1339	23555	87035	64201	22
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47	6694	893 0569	924 3905	957 2917	989 0069	77243	42713	22019	13
48	863 1768	893 0569	925 4700	958 4073	990 1584	83226	48918	28463	12
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59	7762	899 3512	930 3427	963 4427	995 3566	49277	17435	99630	1
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	49°	48°	47°	46°	45°	44°	43°	42°	

	48°	49°	50°	51°	52°	53°	54°	
0	1.11 06125	1.15 03684	1.19 17536	1.23 48972	1.27 99416	1.32 70449	1.37 63819	60
1	12624	10445	24579	56319	1.28 07094	78483	72242	59
2	18127	17210	31626	63672	14776	86524	80672	58
3	25635	23979	38679	71030	22465	94571	89108	57
4	32146	30754	45736	78393	30160	1.33 02624	97551	56
5	38662	37532	52799	85762	37860	10684	1.38 06001	55
6	45182	44316	59866	93136	45566	18750	14458	54
7	51706	51104	66938	1.24 00515	53277	26822	22922	53
8	58235	57896	74015	07900	60995	34900	31392	52
9	64768	64693	81097	15290	68718	42984	39869	51
10	71305	71495	88184	22685	76447	51075	48353	50
11	77846	78301	95276	30086	84182	59172	56844	49
12	84391	85112	1.20 02373	37492	91922	67276	65342	48
13	90941	91927	09475	44903	99669	75386	73847	47
14	97495	98747	16581	52320	1.29 07421	83502	82358	46
15	1.12 04053	1.16 05571	23693	59742	15179	91624	90876	45
16	10616	12400	30810	67169	22943	99753	99401	44
17	17183	19264	37932	74602	30713	1.34 07888	1.39 07934	43
18	23754	26073	45058	82040	38488	16029	16473	42
19	30329	32916	52190	89484	46270	24177	25019	41
20	36909	39763	59327	96933	54057	32331	33571	40
21	43493	46615	66468	1.25 04388	61850	40492	42131	39
22	50081	53472	73615	11848	69649	48658	50698	38
23	56674	60334	80767	19313	77454	56832	59272	37
24	63271	67200	87924	26784	85265	65011	67852	36
25	69872	74071	95085	34260	93081	73198	76440	35
26	76478	80947	1.21 02252	41742	1.30 00904	81390	85034	34
27	83088	87827	09424	49229	08733	89589	93636	33
28	89702	94712	16601	56721	16567	97794	1.40 02245	32
29	96321	1.17 01601	23783	64219	24407	1.35 06006	10860	31
30	1.13 02944	08496	30970	71723	32254	14224	19483	30
31	09571	15395	38162	79232	40106	22449	28113	29
32	16203	22298	45359	86747	47964	30680	36749	28
33	22839	29207	52562	94267	55828	38918	45393	27
34	29479	36120	59769	1.26 01792	63699	47162	54044	26
35	36124	43038	66982	09323	71575	55413	62702	25
36	42773	49960	74199	16860	79457	63670	71367	24
37	49427	56888	81422	24402	87345	71934	80039	23
38	56085	63820	88650	31950	95239	80204	88718	22
39	62747	70756	95883	39503	1.31 03140	88481	97406	21
40	69414	77698	1.22 03121	47062	11046	96764	1.41 06098	20
41	76086	84644	10364	54626	18958	1.36 05054	14799	19
42	82761	91595	17613	62196	26876	13350	23506	18
43	89441	98551	24866	69772	34801	21653	32221	17
44	96126	1.18 05512	32125	77353	42731	29963	40943	16
45	1.14 02816	12477	39389	84940	50668	38279	49673	15
46	09508	19447	46658	92532	58610	46602	58400	14
47	16206	26422	53932	1.27 00130	66559	54931	67153	13
48	22908	33402	61211	07733	74513	63267	75904	12
49	29615	40387	68496	15342	82474	71610	84662	11
50	36326	47376	76786	22957	90441	79959	93427	10
51	43041	54370	83081	30578	98414	88315	1.42 02200	9
52	49762	61369	90381	38204	1.32 06393	96678	10979	8
53	56486	68373	97687	45835	14379	1.37 05047	19766	7
54	63216	75382	1.23 04997	53473	22370	13423	28661	6
55	69949	82395	12313	61116	30368	21806	37362	5
56	76687	89414	19634	68765	38371	30195	46171	4
57	83429	96437	26961	76419	46381	38591	54988	3
58	90176	1.19 03465	34292	84079	54397	46994	63811	2
59	96928	10498	41629	91745	62420	55403	72642	1
60	1.16 03684	17536	48972	99416	70448	63819	81480	0
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NAT. COTAN.

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2	99178	44231	18280	24082	64748	43803	65250	58
3	1.43 08039	53554	28108	34465	75741	55488	77664	57
4	16906	62884	37946	44858	86744	67144	90086	56
5	25781	72223	47792	55260	97758	78833	1.81 02521	55
6	34664	81570	57647	65672	1.67 08782	90533	14969	54
7	43554	90925	67510	76094	19818	1.74 02245	27430	53
8	52451	1.49 00288	77383	86525	30864	13969	39904	52
9	61356	09659	87264	96966	41921	25705	52391	51
10	70268	19039	97155	1.61 07417	52988	37453	64892	50
11	79187	28426	1.55 07054	17878	64067	49213	77405	49
12	88114	37822	16963	28349	75156	60984	89932	48
13	97049	47225	26880	38829	86256	72768	1.82 02473	47
14	1.44 05991	56637	36806	49320	97367	84564	15020	46
15	14940	66058	46741	59820	1.68 08489	96371	27593	45
16	23897	75480	56685	70330	19621	1.75 08191	40173	44
17	32862	84923	66639	80850	30765	20023	52767	43
18	41834	94367	76601	91380	41919	31866	65374	42
19	50814	1.50 03821	86572	1.62 01920	53085	43722	77994	41
20	59801	13282	96552	12469	64261	55590	90628	40
21	68796	22751	1.56 06542	23029	75449	67470	1.83 03275	39
22	77798	32229	16540	33599	86647	79332	15936	38
23	86808	41716	26548	44178	97856	91267	28610	37
24	95825	51210	36564	54768	1.69 09077	1.76 03183	41297	36
25	1.45 04850	60713	46590	65368	20308	15112	53999	35
26	13883	70224	56625	75977	31550	27053	66713	34
27	22923	79743	66669	86597	42804	39007	79442	33
28	31971	89271	76722	97227	54069	50972	92184	32
29	41027	98807	86784	1.63 07867	65344	62950	1.84 04940	31
30	50090	1.51 08352	96856	18517	76631	74940	17709	30
31	59161	17905	1.57 06936	29177	87929	86943	30492	29
32	68240	27466	17026	39847	99238	98958	43289	28
33	77326	37036	27126	50528	1.70 10559	1.77 10985	56099	27
34	86420	46614	37234	61218	21890	23024	68923	26
35	95522	56201	47352	71919	33233	35076	81761	25
36	1.46 04632	65796	57479	82630	44587	47141	94613	24
37	13749	75400	67615	93351	55953	59218	1.85 07470	23
38	22874	85012	77760	1.64 04082	67329	71307	20358	22
39	32007	94632	87915	14824	78717	83409	33252	21
40	41147	1.52 04261	98079	25576	90116	95524	46159	20
41	50296	13899	1.58 08253	36338	1.71 01527	1.78 07651	59080	19
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43	68616	33200	28628	57893	24382	31943	84965	17
44	77788	42863	38830	68687	35827	44107	97928	16
45	86967	52535	49041	79490	47283	56235	1.86 10905	15
46	96155	62215	59261	90304	58751	68475	23896	14
47	1.47 05350	71904	69491	1.65 01128	70230	80678	36902	13
48	14553	81602	79731	11963	81720	92893	49921	12
49	23764	91308	89979	22808	93222	1.79 05121	62955	11
50	32983	1.53 01023	1.59 00238	33663	1.72 04736	17362	76003	10
51	42210	10746	10505	44529	16261	29616	89065	9
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53	60688	30219	31070	66292	39346	54162	15231	7
54	69938	39969	41366	77189	50905	66454	28336	6
55	79197	49727	51672	88097	62477	78759	41455	5
56	88463	59494	61987	99016	74060	91077	54588	4
57	97738	69270	72312	1.66 09945	85654	1.80 03408	67736	3
58	1.48 07021	79054	82647	20884	97260	15751	80898	2
59	16311	88848	92991	31834	1.73 08878	28108	94074	1
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	62°	63°	64°	65°	66°	67°	68°	
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2	33690	54364	83349	77683	95580	96683	92386	58
3	46924	68518	48581	94021	2-25 13221	2-30 15801	2-48 13190	57
4	60172	82688	63732	2-15 10378	30885	34046	34023	56
5	73436	96874	78950	26757	48572	54118	54887	55
6	86713	1-97 11077	94187	43156	66283	73316	75781	54
7	1-89 00006	25296	2-06 09442	59575	84016	92540	96706	53
8	13313	39531	24716	76015	2-26 01773	2-37 11791	2-49 17660	52
9	26635	53782	40008	92476	19554	31068	38645	51
10	39971	68050	55318	2-16 08958	37357	50372	59661	50
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13	80068	1-98 10952	2-07 01359	58527	90909	2 38 08444	22891	47
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15	1-90 06874	39636	32146	91677	26729	47293	65198	45
16	20299	54003	47567	2-17 08283	44674	66758	86398	44
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18	47193	82787	78465	41559	80636	2-39 05769	28890	42
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20	74147	1-99 11637	2-08 09438	74920	2-28 16693	44889	71507	40
21	87647	26087	24953	91631	34758	64490	92863	39
22	1-91 01162	40554	40487	2-18 08364	52846	84118	2-52 14249	38
23	14691	55038	56039	25119	70959	2-40 03774	35667	37
24	28236	69539	71610	41894	89096	23457	57117	36
25	41795	84056	87200	58691	2-29 07257	43168	78598	35
26	55370	98590	2-09 02809	75510	25442	62906	2-53 00111	34
27	68960	2-00 13142	18437	92349	43651	82672	21655	33
28	82565	27710	34085	2-19 09210	61885	2-41 02465	43231	32
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30	1-92 09821	56897	65436	42997	98425	42136	86479	30
31	23472	71516	81140	59923	2-30 16732	62013	2-54 08151	29
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33	50819	2-01 00806	2-10 12607	93840	53420	2-42 01851	51591	27
34	64516	15477	28369	2-20 10831	71801	21812	73359	26
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36	91956	44869	59951	44878	2-31 08637	61819	2-55 16992	24
37	1-93 05699	59592	75771	61934	27092	81864	38858	23
38	19457	74331	91611	79012	45571	2-43 01938	60756	22
39	33231	89088	2-11 07470	96112	64076	22041	82686	21
40	47020	2-02 05862	23348	2-21 13234	82606	42172	2-56 04649	20
41	60825	18654	39246	30379	2-32 01160	62331	26645	19
42	74645	33462	55164	47545	19740	82519	48674	18
43	88481	48289	71101	64733	38345	2-44 02736	70736	17
44	1-94 02333	63133	87057	81944	56975	22982	92830	16
45	16200	77994	2-12 03034	99177	75630	43256	2-57 14957	15
46	30083	92873	19030	2-22 16432	94311	63559	37118	14
47	43981	2-03 07769	35046	33709	2-33 13017	83891	59312	13
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54	41713	2-04 12540	47714	55280	44672	27030	2-59 15606	6
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56	69780	42634	80085	90218	82519	68191	60564	4
57	88837	57708	96301	2-24 07721	2-35 01481	88816	83096	3
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	69°	70°	71°	72°	73°	74°	75°	
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3	2-61 18995	49554	2-91 24649	68468	3-28 10907	89356	51207	57
4	41766	74561	52256	99122	45164	3-50 27916	04963	56
5	64571	99608	79909	3-09 29831	79487	66555	3-75 38815	55
6	87411	2-76 24695	2-92 07610	60596	3-29 13876	3-51 05273	82763	54
7	2-62 10286	49822	35358	91416	48330	44070	3-76 26807	53
8	33196	74990	63152	3-10 22291	82851	82940	70947	52
9	56141	2-77 00199	90995	53223	3-30 17438	3-52 21902	3-77 15185	51
10	79121	25448	2-93 18885	84210	52091	60938	59519	50
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12	25186	76069	74807	46353	3-31 21598	39251	48481	48
13	48271	2-78 01440	2-94 02840	77509	56452	78528	93109	47
14	71392	26853	30921	3-12 08722	91373	3-54 17886	3-79 37835	46
15	94549	52307	59060	39991	3-32 26362	57325	82661	45
16	2-64 17741	77802	87227	71317	61419	96846	3-80 27585	44
17	40969	2-79 03339	2-95 15453	3-13 02701	96543	3-55 36449	72609	43
18	64232	28917	43727	34141	3-33 31736	76133	3-81 17733	42
19	87531	54537	72050	65639	66997	3-56 15900	62957	41
20	2-65 10867	80198	2-96 00422	97194	3-34 02326	55749	3-82 08281	40
21	34238	2-80 05901	28842	3-14 28607	37724	95581	53707	39
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24	2-66 04569	83263	2-97 14399	3-15 23994	44333	3-58 15975	90591	36
25	28085	2-81 09134	43016	55840	80008	56241	3-84 36424	35
26	51638	35048	71683	87744	3-36 15753	96590	82358	34
27	75227	61004	2-98 00400	3-16 19706	51568	3-59 37024	3-85 28396	33
28	98853	87003	29167	51728	87453	77543	74527	32
29	2-67 22516	2-82 13045	67983	83808	3-37 23408	3-60 18146	3-86 20782	31
30	46215	39129	86850	3-17 15948	59434	58835	67131	30
31	69951	65256	2-99 15766	48147	95531	99609	3-87 13584	29
32	93729	91426	44734	80406	3-38 31699	3-61 40469	60142	28
33	2-68 17535	2-83 17639	73751	3-18 12724	67938	81415	3-88 06805	27
34	41383	43896	3-00 02820	45102	3-39 04249	3-62 22447	53574	26
35	65267	70196	51939	77540	40631	63566	3-89 00448	25
36	89190	96539	61109	3-19 10039	77085	3-63 04771	47429	24
37	2-69 13149	2-84 22926	90330	42598	3-40 13612	46064	94516	23
38	37147	49356	3-01 19603	75217	50210	87444	3-90 41710	22
39	61181	75831	48926	3-20 07897	86882	3-64 28911	89011	21
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42	33513	55517	37207	3-21 06304	97333	53844	3-92 31563	18
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52	77102	2-88 24033	34870	38346	70315	76104	3-97 13868	8
53	2-73 01674	51132	64928	71895	3-46 08026	3-70 18830	62712	7
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59	49927	2-90 14688	46400	74529	3-48 35896	77131	58165	1
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	76°	77°	78°	79°	80°	81°	82°	
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1	57570	72316	4-71 13686	525557	809446	256001	304190	59
2	4-02 07446	4-34 30018	81250	605813	906394	376126	455308	58
3	57440	87866	4-72 49012	686311	5-7 003663	496092	607056	57
4	4-03 07550	4-35 45861	4-73 16354	767051	101256	616502	759437	56
5	57779	4-36 04003	85083	848035	199173	737359	912456	55
6	4-04 08125	62293	4-74 53401	929204	297416	858665	7-2 060116	54
7	58550	4-37 20731	4-75 21907	5-2 010738	395988	980422	220422	53
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